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Editorial

Poor Oral Health May Affect the Heart Health

Prof. Dr. Azhar Masud Bhatti
Editor-in-Chief

Introduction

People who have poor oral health (such as gum disease or tooth loss) have higher rates of cardiovascular problems such as heart attack or stroke than people with good oral health.

According to the World Health Organization (WHO), an estimated one billion people around the globe are living with a severe periodontal disease.

Periodontal disease is an umbrella term for a group of inflammatory conditions that affect your teeth, gums, and surrounding tissues. One type of periodontal disease is the gum disease periodontitis, which can cause damage to the tissues and bone supporting your teeth.

When a person has periodontitis, bacteria that enter the gums can spread into the bloodstream, allowing them to reach all parts of the body. Past studies show that periodontitis can increase a person's risk for several health conditions, including rheumatoid arthritis, pneumonia, diabetes, Alzheimer's disease, and cardiovascular disease.

A new study presented at the American Heart Association's Basic Cardiovascular Sciences Scientific Sessions 2026 has found a link between periodontitis and a cardiovascular condition called calcific aortic valve stenosis (CAVS), which can ultimately restrict blood flow from the heart and throughout the body.

Periodontal disease is one of the most common inflammatory diseases in humans that destroys hard and soft tissues around the tooth, resulting in tooth loosening and loss[1]. Severe periodontal disease affects 10.8% of the world's population and is the sixth most common disease worldwide, with more than 700 million people suffering from severe periodontal disease[2]. Periodontal disease can cause inflammation of periodontal tissue but also produce inflammatory mediators and can products that can cardiovascular health through blood circulation[3]. In recent decades, longitudinal studies have revealed a firm link between periodontal tissue and an increased risk of CVD. However, no study has systematically studied the prevalence of CVD in patients with periodontal disease. Moreover, female sex is considered to have a protective effect on the incidence and development of CVD[4,5]. However, whether there is a sex difference in the relationship between periodontal disease and the risk of CVD remains unexplored. Hence, the present study aimed to (i) systematically evaluate the prevalence of CVD in patients with periodontal disease, and (ii) examine the sex-specific association of periodontal disease with CVD.

The bacteria that infect the gums and cause gingivitis and periodontitis also travel to blood vessels elsewhere in the body where they cause blood vessel inflammation and damage; tiny blood clots, heart attack and stroke may follow. Supporting this idea is the finding of remnants of oral bacteria within atherosclerotic blood vessels far from the mouth.

Rather than bacteria causing the problem, it's the body's immune response — inflammation — that sets off a cascade of vascular damage throughout the body, including the heart and brain.

There may be no direct connection between gum disease and cardiovascular disease; the reason they may occur together is that there is a third factor (such as smoking) that's a risk factor for both conditions. Other potential "confounders" include genetic contributions to both disorders, poor access to healthcare and lack of exercise — perhaps people without health insurance or who don't take good care of their overall health are more likely to have poor oral health and heart disease.

In a study, researchers used several methods, including human heart tissue and a mouse model, to search for a potential link between periodontitis and Calcific Aortic Valve Stenosis (CAVS).

Chenyang Li, MD, Department of Cardiology in Fuwai Hospital at the National Center for Cardiovascular Diseases at the Chinese Academy of Medical Sciences and Peking Union Medical College in China said "CAVS is the most common valvular heart disease in older adults, affecting approximately 2%–7% of people over the age of 65."

"Currently, no medications have been proven to prevent or slow its progression, and once severe stenosis develops, valve replacement is often the only effective treatment. Therefore, identifying modifiable risk factors and understanding the mechanisms driving valve calcification could open new opportunities for prevention and early intervention, potentially reducing the need for invasive procedures." — Chenyang Li, MD

Li said he and his team decided to look for a potential link between periodontitis and CAVS, as chronic inflammation is recognized as a key driver of CAVS.

"Porphyromonas gingivalis (P. gingivalis), one of the major bacteria responsible for periodontal disease, can enter the bloodstream during routine activities such as brushing or chewing in people with poor oral health, and has been associated with several cardiovascular diseases," he explained.

Periodontal (gum) disease has long been associated with a higher risk of atherosclerosis, the buildup of plaque in the arteries, largely due to chronic inflammation. Over time, this inflammation can accelerate the deposition of fatty material in artery walls, increasing the risk of serious events like heart attack and stroke." (Yu-Ming Ni, MD)

"What makes this study especially compelling is the potential link between gum disease and CAVS. While this connection may sound surprising, it aligns with the broader understanding that inflammation plays a central role in many forms of cardiovascular disease." Ni continued.

Gum disease (periodontitis) is independently associated with an increased risk of cardiovascular disease (CVD) and major heart events, primarily driven by systemic inflammation and the movement of oral bacteria into the bloodstream.

A statement published in Circulation by the American Heart Association indicates that periodontal disease is linked to plaque buildup in arteries (atherosclerosis), heart attacks, stroke, atrial fibrillation, and heart failure.

A large-scale meta-analysis published in PubMed Central found that individuals with periodontal disease have a pooled cardiovascular disease prevalence of 7.2%, including specific rates for hypertension (25.3%), coronary heart disease (6.6%), and heart failure (1.1%).

A Research highlighted by the British Heart Foundation points to Porphyromonas gingivalis, an oral bacterium that can enter the bloodstream during gum infections, promote arterial plaque, and correlate with greater heart muscle damage and subclinical Arterial Changes also show that periodontal disease is associated with a 42% increased odds of thickened carotid intima-media thickness (cIMT) and up to 70% higher odds in severe cases, indicating early structural changes in blood vessels.

According to the American Heart Association Journals, Chronic inflammation in the gums raises whole-body inflammatory markers—such as C-reactive protein (CRP), IL-6, and TNF-alpha—which damage endothelial cells and accelerate atherosclerosis.

According to European Federation of Periodontology Oral bacteria can slip through permeable, inflamed gum tissue into the circulatory system, attaching directly to heart valves or arterial walls.

Cardiovascular disease (CVD) remains the leading cause of death, accounting for approximately one third of all deaths worldwide. The global incidence of CVDs is 10~30%, showing a gradually increasing trend[6-8]. China has the highest cardiovascular mortality rate, followed by India, the Russian Federation and the United States of America[9]. However, periodontal disease is increasingly becoming one of the major obstacles to optimal outcomes for patients with cardiovascular disease (CVD)[10].

Americans had the highest prevalence of CVD (ES: 13.3%), followed by Europeans (ES: 12%), Asians (ES: 8.2%), and Oceania (ES: 2%) (P for subgroup difference < 0.001). The pooled prevalence was 25.3% for HP, 6.6% for coronary heart disease (CHD), 1% for stroke, and 1.1% for HF.

Age is a vital risk factor for both CVD and periodontal disease. In subgroup analyses, younger patients with periodontal disease were shown to have an increased risk of CVD, with a prevalence of 23.8% in the younger group (age <45 years) versus 7.5% in older one (age ≥45 years). This was consistent with Joshipura et al. (34) who reported a stronger effect for younger men than for older men (≤55 years: RR = 2.17; 95% CI: 1.22–3.84 vs. >55 years: RR = 1.21; 95% CI: 0.92–1.59). Similarly, in a case-control study, four cases of clinical attachment loss of 4.5 to ≤6 mm were associated with a significantly increased risk of stroke (OR = 3.43; 95% CI: 1.39–8.50) in men ≤60 years, while there was no statistical significance in younger men (age >60 years) (OR = 1.71; 95% CI: 0.65–4.5). Men who were susceptible to periodontitis were shown to develop periodontal destruction earlier than those who were not. Thus, there is a stronger association between periodontitis and cerebrovascular disease in young men than in older men, which may further support the hypothesis of proinflammatory susceptibility.

Diagnosis and Tests

A dentist can tell you if you have gum disease during a routine examination. They'll look for plaque buildup on your teeth and ask you about your symptoms. They may refer you to a periodontist (gum specialist) for further evaluation and treatment.

A dentist or periodontist will measure the pockets around your teeth using an instrument called a periodontal probe. This tells them how much bone you've lost around your teeth. The deeper the pockets, the more severe the gum disease you have. Your periodontist will check your bite, how loose your teeth are and how much your gums are pulling away from your teeth (receding).

Additionally, they'll take dental X-rays. These images show the areas of bone loss in detail. They can also look at older X-rays to see how your bone has changed over time.

Management and Treatment

Gum disease isn't curable, but it's manageable with appropriate treatment. You can't cure it because once you lose structural support around your teeth, you don't usually get all of it back. However, periodontal treatment can reduce infection and rebuild your bone and tissue to some degree.

Another factor is genetics. There are many different types of oral bacteria. Some people are simply more prone to having the kind that causes gum disease.

One stage of gum disease is totally reversible — gingivitis (very early periodontal disease). If you detect gingivitis early enough, you can reverse it with regular dental cleaning and diligent oral hygiene.

There are several periodontal treatments available.

Dental cleaning and improved oral hygiene

Proper oral hygiene includes brushing two to three times a day, flossing daily and visiting your dentist for regular exams and cleanings.

Scaling and root planning

Scaling and root planning is similar to routine dental cleaning. But it cleans deeper beneath your gums, removing plaque and bacteria where your toothbrush and floss can't reach. Periodontists recommend this treatment for people with mild gum disease.

Pocket reduction surgery

People with moderate to advanced gum disease may need pocket reduction surgery (also called osseous surgery). The goal is to remove plaque and tartar that are so deep under the gums that your hygienist can't reach it. During this procedure, a periodontist makes an incision (cut) in your gums and creates a flap. This allows them to temporarily move your gums back from your teeth roots.

Oftentimes, periodontists combine pocket reduction surgery with other regenerative procedures, such as bone grafting, gum grafting or guided tissue regeneration.

LANAP (Laser-assisted new attachment procedure)

Some periodontists also offer pocket reduction with LANAP. This procedure treats periodontitis using a handheld laser. The laser targets diseased gum tissue while leaving healthy tissue intact.

LANAP is a less-invasive alternative to traditional pocket reduction surgery. But results are mixed.

Bone grafting

Your periodontist may use a dental bone graft to replace bone that you've lost to gum disease. Once they clean the infection out, they'll place bone grafting material into the areas where the bone has eroded. This material acts as scaffolding or a space-holder, giving your body time to regenerate its own bone over time.

Gum grafting

If you've lost gum tissue to periodontal disease, your dentist may recommend gum graft surgery, also called tissue grafting. This procedure covers exposed teeth roots and adds thickness to your gum line.

Guided tissue regeneration (GTR)

Usually, periodontists use guided tissue regeneration in combination with a bone graft. GTR helps repair periodontal defects (areas of broken-down bone) and prevents soft tissue from growing into these areas.

Platelet-rich fibrin (PRF) and platelet-rich plasma (PRP)

Platelet-rich fibrin (PRF) and platelet-rich plasma (PRP) contain growth factors that speed up healing and tissue regeneration. A periodontist can get PRF and PRP from a small sample of your blood. They'll spin the sample in a centrifuge (a lab machine that spins rapidly, using centrifugal force) to separate plasma from your red blood cells. Then they'll place the platelet-rich plasma or fibrin at the surgical site.

In addition to boosting healing, this type of therapy can also shorten recovery times and reduce post-surgical pain. And because it comes from your own blood, it's completely safe.

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Original Article

Integrated Ultrasound and Cytological Assessment of Breast Cysts: A Cross-Sectional Diagnostic Study for Predicting Malignancy

Zinah Akram Hussein[1], Dina Akram Hussein[2] and Radhwan Hussein Ibrahim[3]

ABSTRACT

Objective: To evaluate the diagnostic performance of an integrated ultrasound and FNAC approach in differentiating benign and malignant breast cystic lesions

Study Design: Cross-sectional diagnostic study

Place and Duration of Study: This study was conducted at the Tertiary Care Hospitals in Mosul, Iraq, from January 2025 to December 2025.

Methodology: Women presenting with breast cystic lesions underwent ultrasound and FNAC evaluation. Histopathology served as the reference standard. Logistic regression and ROC curve analysis were performed to assess diagnostic performance.

Results: Complex cyst morphology, irregular margins, vascularity, and suspicious FNAC findings were significantly associated with malignancy ($p < 0.001$). The integrated model demonstrated superior diagnostic accuracy (AUC = 0.93) compared to ultrasound alone (AUC = 0.81). Sensitivity and specificity exceeded 90%.

Conclusion: The combined ultrasound–FNAC approach significantly enhances diagnostic accuracy and supports clinical decision-making in breast cyst evaluation.

Key Words: Breast cysts; Ultrasound; FNAC; Malignancy; Diagnostic accuracy.

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INTRODUCTION

Breast cystic lesions are common in clinical practice, particularly among women of reproductive age[1]. Although most are benign, a small proportion may contain atypical or malignant pathology, making accurate differentiation essential[2-4]. Ultrasonography is widely used because it is accessible, cost-effective, and effective in distinguishing cystic from solid lesions. Simple cysts typically show benign features, including anechoic content, thin walls, and posterior acoustic enhancement[5]. However, complicated or complex cysts with internal echoes, septations, mural nodules, or irregular margins may overlap with malignant features, limiting the diagnostic accuracy of ultrasound alone[6,7]. Fine-needle aspiration cytology (FNAC) provides complementary cytological assessment and is minimally invasive and inexpensive. Nevertheless, inadequate sampling, operator dependency, and interpretive variability may limit its diagnostic value[8]. Residual masses after aspiration may further raise concern for underlying malignancy[9].

Integrating ultrasound and cytological findings may improve diagnostic accuracy, yet standardized predictive models for breast cystic lesions remain limited[10]. Such an approach may be particularly valuable in resource-limited settings. Therefore, this study aimed to develop and evaluate a predictive model combining ultrasound features and FNAC findings to differentiate benign from malignant breast cystic lesions and identify key predictors of malignancy.

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METHODOLOGY

Study Design: A prospective observational diagnostic study was conducted to evaluate the clinical, ultrasonographic, and cytological characteristics of cystic breast lesions and to identify factors associated with malignancy. Histopathological examination, when available, was used as the reference standard for definitive diagnosis.

Place and Duration of the Study: The study was conducted at the radiology and breast clinics of tertiary care hospitals in Mosul, Iraq, over a 12-month period from January to December 2025. Eligible women presenting to the participating clinics during the study period were assessed for inclusion.

Study Population and Sampling: The study population comprised adult women presenting with breast lumps or lesions suspected to have a cystic component. A consecutive sampling technique was employed, whereby all eligible women presenting during the study period were invited to participate until the required sample was achieved.

Eligibility Criteria: Women aged 18 years or older were eligible if they had a breast lesion suggestive of a cystic nature on clinical examination or imaging, underwent breast ultrasonography, and had FNAC and/or histopathological confirmation. Women with a previously diagnosed breast malignancy, solid breast masses without cystic components, incomplete imaging or cytological/histopathological data, or those who declined participation were excluded.

Breast Ultrasonography: Breast ultrasonography was performed by experienced radiologists using a high-frequency linear transducer (7.5–12 MHz). Each lesion was systematically evaluated for size, laterality, number, cyst type, internal echoes, septations, wall characteristics, posterior acoustic features, and Doppler vascularity. Cystic lesions were classified as simple, complicated, or complex according to standard sonographic criteria. Based on the overall ultrasonographic appearance, lesions were further categorized as benign or suspicious for malignancy.

Fine-Needle Aspiration Cytology: Fine-needle aspiration cytology (FNAC) was performed under aseptic conditions using a 22–25-gauge needle, either with or without ultrasound guidance according to lesion characteristics and clinical requirements. Aspirated material was appropriately processed and examined by experienced cytopathologists. Cytological findings were categorized as benign, atypical, suspicious, or malignant. For aspirated cystic lesions, the presence or absence of a residual mass following aspiration was also documented.

Histopathological Reference Standard: Histopathological examination of biopsy or surgically excised specimens was considered the reference standard for definitive diagnosis. Based on histopathological findings, lesions were classified as benign or malignant. Histopathological results were subsequently compared with ultrasonographic and cytological findings to assess their diagnostic performance.

Outcome Measures: The primary outcome was the presence of malignancy among cystic breast lesions. Secondary outcomes included the identification of ultrasonographic and cytological characteristics significantly associated with malignancy and the evaluation of the diagnostic performance of ultrasonography, FNAC, and the integrated diagnostic model.

Statistical Analysis: Data was analyzed using IBM SPSS Statistics version 28.0. Continuous and categorical variables were summarized as mean ± SD and frequencies with percentages, respectively. Associations with malignancy were assessed using Chi-square or Fisher's exact tests, followed by multivariable logistic regression to identify independent predictors, reported as adjusted odds ratios (AORs) with 95% CIs. Diagnostic performance was evaluated using sensitivity, specificity, PPV, NPV, and ROC analysis with AUC. A two-sided $p<0.05$ was considered statistically significant.

RESULTS

Participant and Clinical Characteristics: A total of 120 women with breast cystic lesions were included in the study. The mean age of the participants was 41.8 ± 11.6 years, with 74 (61.7%) aged 40 years or older and 46 (38.3%) aged younger than 40 years. Regarding lesion laterality, 52 (43.3%) lesions involved the right breast, 48 (40.0%) involved the left breast, and 20 (16.7%) were bilateral. Most participants had a single cystic lesion (66.7%), whereas 33.3% had multiple lesions. The mean cyst size was 18.6 ± 7.9 mm (Table No. 1).

Ultrasound Characteristics According to Histopathological Diagnosis: Histopathology identified 96 (80.0%) benign and 24 (20.0%) malignant lesions. Simple cysts were more frequent among benign lesions (60.4% vs. 8.3%), whereas complex cysts were more common among malignant lesions (66.7% vs. 18.8%; $p<0.001$). Malignant lesions also showed significantly higher frequencies of internal echoes (75.0% vs. 22.9%), septations (62.5% vs. 14.6%), irregular margins (70.8% vs. 10.4%), and Doppler vascularity (79.2% vs. 12.5%). All associations were statistically significant ($p<0.001$) (Table No. 2).

FNAC Findings According to Histopathological Diagnosis: FNAC findings showed a clear distribution according to the final histopathological diagnosis. Among the 96 histopathologically benign lesions, FNAC classified 72 as benign, 16 as atypical, 6 as suspicious, and 2 as malignant. In contrast, among the 24 histopathologically malignant lesions, only 2 were classified as benign by FNAC, while 4 were atypical, 8 were suspicious, and 10 were classified as malignant. Thus, suspicious and malignant cytological findings occurred predominantly among histopathologically

confirmed malignant lesions, demonstrating substantial agreement between FNAC findings and the definitive diagnosis (Table No. 3).

Independent Predictors of Malignancy: Multivariable logistic regression analysis identified several independent predictors of malignancy. Complex cyst morphology was associated with approximately a fivefold increase in the odds of malignancy (AOR = 4.8; 95% CI: 2.1–10.9; $p < 0.001$). Lesions with irregular margins had 5.6 times higher odds of malignancy (AOR = 5.6; 95% CI: 2.4–13.1; $p < 0.001$), while the presence of Doppler vascularity was associated with 6.9-fold greater odds (AOR = 6.9; 95% CI: 3.0–15.8; $p < 0.001$).

The strongest independent predictor was a suspicious or malignant FNAC result, which was associated with a 12.5-fold increase in the odds of histopathological confirmed malignancy (AOR = 12.5; 95% CI: 5.2–29.8; $p < 0.001$). These findings indicate that cytological findings provided the greatest independent contribution to malignancy prediction, followed by Doppler vascularity, irregular margins, and complex cyst morphology (Table No. 4).

Table No. 1. Demographic and Clinical Characteristics (n = 120)

Variable	Category	n (%)
Age (years)	Mean ± SD	41.8 ± 11.6
Age group	<40	46 (38.3)
	≥40	74 (61.7)
Laterality	Right	52 (43.3)
	Left	48 (40.0)
	Bilateral	20 (16.7)
Number of cysts	Single	80 (66.7)
	Multiple	40 (33.3)
Cyst size (mm)	Mean ± SD	18.6 ± 7.9

Table No. 2: Ultrasound Features vs Histopathological Outcome

Feature	Benign n=96	Malignant n=24	p-value
Simple cyst	58 (60.4%)	2 (8.3%)	<0.001
Complex cyst	18 (18.8%)	16 (66.7%)	<0.001
Internal echoes	22 (22.9%)	18 (75.0%)	<0.001
Septations	14 (14.6%)	15 (62.5%)	<0.001
Irregular margins	10 (10.4%)	17 (70.8%)	<0.001
Doppler vascularity	12 (12.5%)	19 (79.2%)	<0.001

Table No. 3: FNAC Results vs Histopathology

FNAC Category	Benign n=96	Malignant n=24
Benign	72	2
Atypical	16	4
Suspicious	6	8
Malignant	2	10

Table No. 4: Multivariate Logistic Regression Analysis

Variable	AOR	95% CI	p-value
Complex cyst	4.8	2.1–10.9	<0.001
Irregular margin	5.6	2.4–13.1	<0.001
Doppler vascularity	6.9	3.0–15.8	<0.001
Suspicious/Malignant FNAC	12.5	5.2–29.8	<0.001

Table No. 5: Diagnostic Accuracy of Models

Model	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	AUC
Ultrasound alone	83.3	78.1	48.5	94.7	0.81
FNAC alone	87.5	90.6	70.0	96.7	0.89
Integrated model	**95.8**	**92.7**	**79.3**	**98.9**	**0.93**

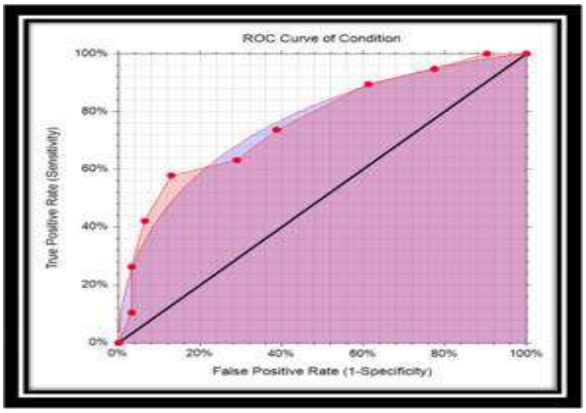


Figure No. 1: ROC Curve Analysis

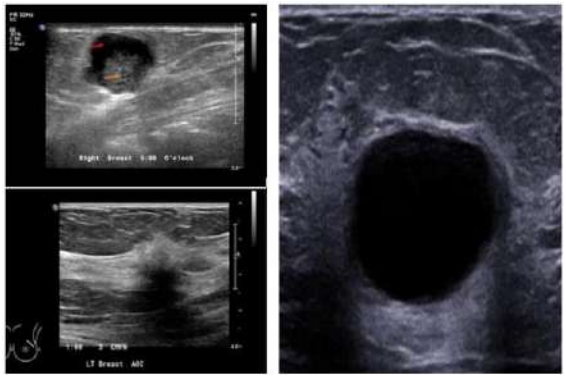


Figure No. 2: Ultrasound Examples (Clinical Relevance)

Diagnostic Performance of Ultrasound, FNAC, and the Integrated Model: The diagnostic performance of the three approaches demonstrated progressive improvement when ultrasonographic and cytological findings were combined. Ultrasound alone achieved a sensitivity of 83.3%, specifically of 78.1%, PPV of 48.5%, NPV of 94.7%, and AUC of 0.81. FNAC alone demonstrated better diagnostic performance, with a sensitivity of 87.5%, specificity of 90.6%, PPV of 70.0%, NPV of 96.7%, and AUC of 0.89.

The integrated ultrasound–FNAC model demonstrated the highest diagnostic performance, achieving a sensitivity of 95.8%, specificity of 92.7%, PPV of 79.3%, and NPV of 98.9%. ROC curve analysis yielded an AUC of 0.93, indicating excellent discrimination between benign and malignant lesions. Overall, the integrated model demonstrated superior diagnostic performance compared with either ultrasound or FNAC used independently (Table No. 5 and Figure No. 1).

DISCUSSION

This study evaluated the diagnostic performance of an integrated ultrasound and cytological approach in differentiating benign and malignant breast cystic lesions. The findings demonstrated that combining ultrasound features with FNAC significantly improves diagnostic accuracy, achieving excellent discrimination (AUC = 0.93), with sensitivity and specificity exceeding 90%. These results support the growing evidence that multimodal diagnostic strategies provide superior clinical value compared to single-modality assessment[11-12].

The overall malignancy rate observed in this study (20%) is consistent with previous reports indicating that the majority of breast cystic lesions are benign, with malignancy rates typically ranging between 15% and 25% in complex cyst categories. Importantly, our findings confirmed that complex cyst morphology, internal echoes, septations, irregular margins, and vascularity were strongly associated with malignancy. Similar associations have been reported in recent imaging studies, where ultrasound-based classification systems such as BI-RADS demonstrated strong predictive capability in distinguishing benign from malignant lesions[13-15].

Ultrasound alone in the present study showed good diagnostic performance (AUC ≈ 0.81), which aligns with recent evidence indicating that ultrasonography achieves diagnostic accuracy around 80–86% with high negative predictive value, particularly in dense breast tissue 29-31. However, ultrasound remains limited in differentiating complicated and complex cysts due to overlapping imaging characteristics. This limitation highlights the need for adjunctive diagnostic tools.

FNAC demonstrated high diagnostic accuracy in this study, consistent with recent literature reporting accuracy rates between 71% and 96%, depending on lesion characteristics and operator expertise. Other contemporary studies have also reported FNAC sensitivity exceeding 90% with strong correlation to histopathology, reinforcing its role as a reliable and minimally invasive diagnostic tool 34. However, FNAC is known to have limitations in borderline or atypical lesions, where false negative or indeterminate results may occur[16-18].

A key finding of this study is the superior performance of the integrated ultrasound–FNAC model, which significantly outperformed either modality alone. This finding is consistent with recent studies emphasizing that combining imaging modalities with cytological or histopathological assessment enhances diagnostic accuracy. For example, a 2025 study reported that combined imaging approaches achieved diagnostic accuracy exceeding 93%, compared to lower performance when modalities were used independently 36-38. Similarly, multimodal ultrasound techniques (e.g., combining conventional ultrasound with elastography or contrast-enhanced imaging) have been shown to significantly improve sensitivity and overall diagnostic performance[19].

The strong predictive value of FNAC observed in the multivariate model (AOR = 12.5) highlights its critical role in confirming malignancy, particularly when ultrasound findings are inconclusive. Moreover, the identification of residual mass after aspiration as a clinically relevant indicator further strengthens the diagnostic pathway, as persistent lesions may warrant closer evaluation and possible biopsy.

From a clinical perspective, the findings of this study have important implications, particularly in resource-limited settings such as Iraq. The integrated approach provides a cost-effective and accessible diagnostic strategy, reducing reliance on more invasive procedures such as core needle biopsy while maintaining high diagnostic accuracy. This aligns with global recommendations advocating stepwise diagnostic evaluation using imaging and minimally invasive techniques[20].

Furthermore, the development of a predictive model offers a structured framework for risk stratification, supporting clinicians in decision-making and potentially reducing unnecessary biopsies in benign cases. This is particularly relevant given the increasing emphasis on personalized and evidence-based breast cancer diagnostics[21-22].

Limitations: Despite its strengths, this study has some limitations. The cross-sectional design limits causal inference, and the sample size, although adequate, may not fully capture all variations of breast cystic lesions. Additionally, FNAC interpretation may be subject to operator variability, and not all cases may have undergone uniform histopathological confirmation. Future multicenter and longitudinal studies are recommended to validate the predictive model.

CONCLUSION

This study demonstrates that combining ultrasound with fine-needle aspiration cytology (FNAC) improves the differentiation of benign and malignant breast cystic lesions. Complex morphology, irregular margins, Doppler vascularity, suspicious cytology, and residual masses after aspiration were important predictors of malignancy. This integrated approach provides high diagnostic accuracy while remaining minimally invasive, cost-effective, and suitable for resource-limited settings, supporting better risk stratification and timely clinical management.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Zinah Akram Hussein, Dina Akram Hussein
Drafting or Revising Critically:	Zinah Akram Hussein, Radhwan Hussein Ibrahim
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

Conflict of Interest: The study has no conflict of interest to declare by any author.

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Original Article

Assessment of Interleukin-1 Alpha, Interleukin-1 Beta, and Oxidative Stress in Patients with Atherosclerotic Cardiovascular Disease in Thi-Qar, Iraq

Fatima Raheem Hassan[1] and Hattf Bazool Farhood[2]

ABSTRACT

Objective: To investigate the changes in interleukin-1 alpha, interleukin-1 beta, malondialdehyde and oxidized low-density lipoprotein in serum of elderly and non-elderly patients with atherosclerotic cardiovascular disease

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the Al-Nasiriya Heart Center and the Biochemistry Laboratory of the College of Science, University of Thi-Qar, from 1st October 2024 to 31st March 2025.

Methodology: 120 samples were enrolled. Sixty patients with atherosclerotic cardiovascular disease were divided by age into two groups: thirty elderly patients (aged 60-79) and thirty non-elderly patients (aged 20- 59), in addition to sixty individuals from the same age groups were divided as a control groups (30 elderly/ 30 non-elderly).

Results: The significant increases ($P \leq 0.05$) in oxidized low-density lipoprotein, malondialdehyde, interleukin-1 alpha, and interleukin-1β concentrations in elderly patients compared to non-elderly patients. In healthy individuals, significant increases in malondialdehyde and interleukin-1 alpha levels were observed only in the elderly group. Moreover, both the elderly and non-elderly patient groups showed significantly higher levels of all the studied parameters compared to their corresponding control groups ($P \leq 0.05$).

Conclusion: Atherosclerotic cardiovascular disease is associated with increased oxidative stress and inflammatory activity, with these abnormalities being more pronounced in elderly patients. The aging may amplify oxidative and inflammatory processes involved in atherosclerotic cardiovascular disease.

Key Words: Elderly, Interluken-1 alpha, Interluken-1 beta, Oxidative stress.

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INTRODUCTION

Disruption of Oxidative balance and activation of inflammatory pathways accelerate atherosclerosis and exacerbate cardiovascular diseases (CVD). According to the oxidative stress theory of aging, the accumulation of reactive oxygen species (ROS) worsens with age, and these species are a double-edged sword; at physiological levels, they maintain cellular homeostasis while excess ROS or weakened antioxidant defenses lead to oxidative stress (OS) associated with vascular wall damage[1]. To detect OS in biological systems (human blood and tissue samples), one of the most widely used biomarkers is Malondialdehyde (MDA). It's a by-product of lipid peroxidation, and is formed when unsaturated fatty acids are oxidized by ROS[2]. Such reactive species are involved in the oxidation of low-density lipoprotein (LDL), leading to the formation of oxidized LDL (OxLDL), which is not only a biomarker of OS but also plays a crucial role in the early stages of atherosclerosis development. Macrophages engulf OxLDL via specific receptors, leading to the formation of foam cells and then plaques[3]. When these plaques rupture, arterial blockage, ischemia, and necrosis of heart tissue occur, as in the case of myocardial infarction. This cellular injury leads to an inflammatory response and promotes the release of several pro-inflammatory cytokines[4], such as Interleukin-1alpha (IL-1α) and Interleukin-1beta (IL-1β). IL-1α is a pro-inflammatory cytokine, and its precursor is found in most cell types under normal

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conditions. When cells are damaged or die, it is released as an alarm signal, triggering a local inflammatory response[5].

Interleukin-1β is a secreted inflammatory cytokine produced by immune cells, particularly macrophages. It is initially synthesized as an inactive precursor (pro-IL-1β), then converted to its active form upon activation of the inflammasome complex (NLRP3), which activates the caspase-1 enzyme. It contributes to vascular inflammation by stimulating the production of other cytokines and increasing the expression of cell adhesion molecules, thus contributing to the development of atherosclerotic plaques[6,7]. Most previous studies have focused on assessing biomarkers of OS or inflammatory mediators separately; therefore, data regarding the interaction between markers of OS and markers of inflammation in cardiovascular patients remain limited, particularly when comparing elderly patients (≥ 60 years) with non-elderly patients (<60 years), as well as with age-matched control groups. Accordingly, this research aimed to assess the levels of OS markers (MDA and OxLDL) and pro-inflammatory cytokines (IL-1α and IL-β) in patients and compare them to age-matched control groups.

METHODOLOGY

This cross-sectional study was conducted at Al-Nasiriya Heart Center and the Biochemistry Laboratory of the College of Science, University of Thi-Qar from 1st October 2024 to 31st March 2025. One hundred and twenty individuals were included (60 patients and 60 controls). They were stratified into two age groups: 30 elderly patients (60-79 years) and 30 non-elderly patients (20–59 years). The same age classification was applied to the control groups. Individuals with thyroid disease, cancers, pregnant women, chronic kidney disease, liver disease and diabetes were excluded. About 5 mL of blood samples were collected in gel tubes and left to coagulate. They were then centrifuged at 3000 rpm for ten minutes, and the serum was separated and stored at -20°C. Serum levels of IL-1α, IL-1β, and OxLDL were measured using enzyme-linked immunosorbent assay (ELISA), while MDA was determined by the TBARS method. All data analyses were carried out using SPSS-25, and t-tests were used to perform comparative analyses.

RESULTS

A highly significant (p≤0.05) difference in age was observed between the studied groups (Table No. 1). Table No. 2 and Figure No. 1 showed that MDA levels were significantly elevated in elderly patients compared with elderly controls and in nonelderly patients compared with their corresponding controls (P≤0.05). In addition, MDA concentrations in elderly patients were significantly higher compared with nonelderly patients, and a similar pattern was observed among controls (P≤0.05).

The OxLDL results indicated a significant increase in all patient groups compared to the control groups (p≤0.05). A significant increase in OxLDL levels was also observed in elderly patients compared to non-elderly patients (p≤0.05). However, in the control groups (elderly and non-elderly) there was no significant (p≤0.05) difference (Table No. 3, Figure No.2).

Table No. 4 and Figure Nos. 3 and 4 showed a significant increase in both IL-1α and IL-1β was observed in all patients compared with their respective controls (P≤0.05). Also, a significant difference was found between elderly and nonelderly patients in both markers (P≤0.05). Among controls, IL-1β levels didn't differ between elderly and non-elderly subjects, whereas IL-1α levels showed a significant difference between the two groups (P≤0.05).

Table No. 1: Demographic and clinical characteristics of the studied groups

Group	No.	Male/Female	Age (years)
Elderly patients	30	15/15	65.70±4.24
Non-elderly patients	30	18/12	48.27±8.92
Elderly control	30	15/15	63.40±4.26
Non-elderly control	30	14/16	42.60±9.57

P<0.001

Table No. 2: Serum MDA values across groups

Groups	Patients	Controls	P value
Elderly	4.06±0.27	1.89±0.27	<0.001
Non-elderly	3.28±0.37	1.64±0.29	<0.001

Table No. 3: Serum OxLDL values across groups

Groups	Patients	Controls	P value
Elderly	4.30±0.55	2.47±0.51	<0.001
Non-elderly	3.19±0.46	2.32±0.50	<0.001

Table No. 4: Serum IL-1α and IL-1β values across groups

Groups	IL-1α (Pg/ml)			IL-1β (Pg/ml)		
	Patients	Controls	P value	Patients	Controls	P value
Elderly	35.36±5.79	24.63±5.51	<0.001	31.14±5.31	20.74±3.65	P<0.001
Non-elderly	31.21±4.28	20.44±5.75	<0.001	26.98±4.37	19.41±4.52	P<0.001

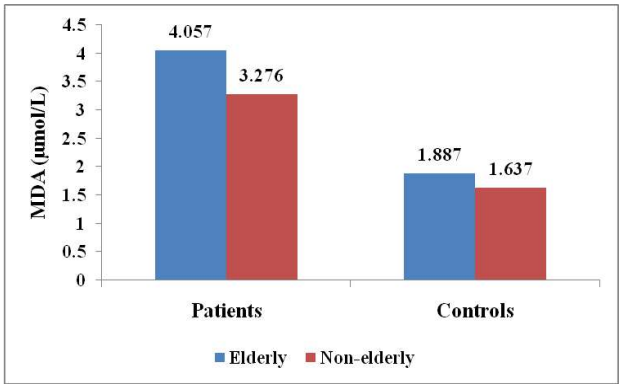


Figure No. 1: Serum MDA levels across groups

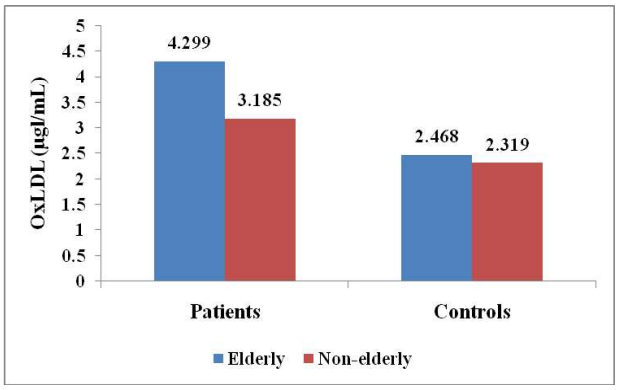


Figure No. 2: Serum OxLDL levels across groups

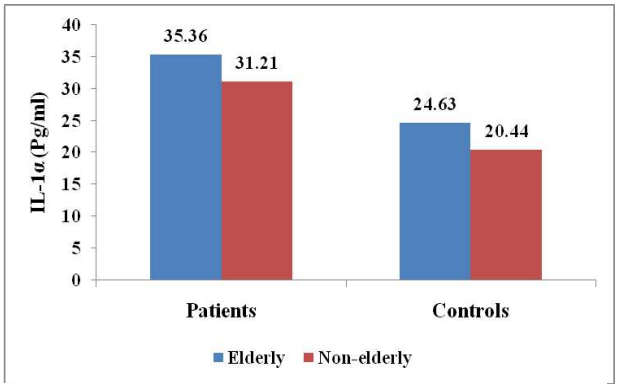


Figure No. 3: Serum IL-1α levels across groups

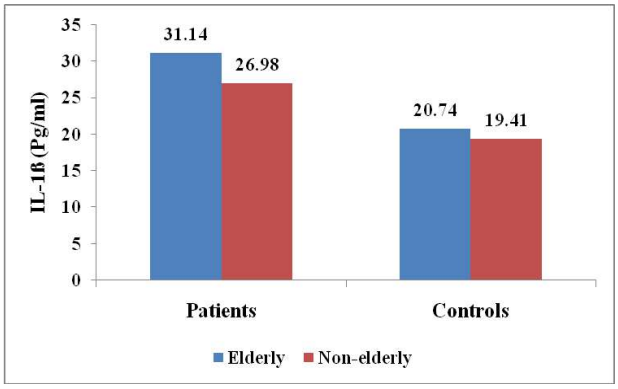


Figure No. 4: Serum IL-1β levels across groups

DISCUSSION

The results of this study showed significantly higher MDA levels in patients compared to control groups, which agrees with recent studies that showed a significant increase in this indicator in patients with MI[8,9]. A cross-sectional study also showed that MDA levels gradually increased with disease severity, supporting the possible role of OS in the development of these diseases[10]. OS contributes to endothelial dysfunction, promotes the inflammatory response, and accelerates atherosclerosis, thereby worsening CVD. During this process, excessive levels of ROS damage cellular macromolecules including lipids, proteins, and DNA, and reduce nitric oxide bioavailability, leading to vasoconstriction and the development of pro-inflammatory and pro-coagulant states within the vasculature[10,11]. Furthermore, the current study showed significantly higher MDA levels in the elderly than in the non-elderly across both patient and control groups ($P<0.05$). This age-related increase can be explained by the synergistic relationship between aging and OS. Aging increases cellular susceptibility to oxidative damage and disrupts the balance of antioxidant systems, promoting lipid peroxidation and increasing the production of its end products, including MDA[12]. Therefore, elevated MDA levels may reflect increased OS associated with both disease progression and aging.

In this research, OxLDL levels were significantly elevated in patients compared to control groups. These results are consistent with recent evidence reported by Rahmanian et al[13] who demonstrated a significant increase in serum OxLDL concentration in patients with MI compared with healthy individuals ($P\leq0.05$). This increase can be attributed to heightened OS and the associated oxidation of LDL molecules, leading to altered biochemical properties and increased vascular damage. OxLDL is a key component in the initiation and progression of atherosclerosis. It contributes to endothelial dysfunction, activates inflammatory responses, and promotes foam cell formation through its uptake by macrophages, ultimately leading to lipid accumulation and the formation and instability of atherosclerotic plaques[14]. A clinical study also showed that elevated OxLDL levels are associated with increased disease severity, with a positive correlation found between OxLDL levels and the number of ischemic events and the number of damaged blood vessels in coronary artery patients, suggesting that it reflects not only the presence of disease but also its severity and the associated oxidative burden[15]. Regarding age, Table No. 3 indicated significant differences in OxLDL levels between elderly and non-elderly patients, while no significant differences were detected between age groups within the control groups.

This may suggest that the effect of aging on OxLDL levels becomes more pronounced in the presence of the disease, as disease-related vascular changes, such as endothelial dysfunction and increased inflammatory activity, promote LDL oxidation and elevated OxLDL levels[16,17]. In healthy individuals, although age-related changes may affect oxidative balance, these changes may not be sufficient to cause a significant increase in OxLDL levels. Therefore, it can be concluded that elevated OxLDL levels are primarily associated with the disease, while aging may act as a contributing factor that exacerbates this increase in the context of the disease.

A significant increase in the levels of both IL-1α and IL-1β was observed in this study, with IL-1α and IL-1β levels being significantly higher in patients compared to control groups. These results agreed with Ibrahim et al[18], who showed a significant increase in IL-1α levels in patients with acute coronary syndrome compared to healthy individuals. Another study conducted on patients with stable angina also demonstrated a significant increase in IL-1β levels compared to the control group, supporting the association of these cytokines with the inflammatory state associated with atherosclerosis and the development of CVD[19]. When analyzing the effect of age within the patient group, the results showed a significant increase in the levels of both IL-1α and IL-1β in elderly patients compared to non-elderly patients. This can be explained by the fact that aging is associated with a chronic, low-grade inflammatory condition known as "inflammaging", which results from increased OS, the accumulation of cellular damage, and increased activity of the innate immune system with advancing age. This inflammatory context contributes to stimulating the immune priming, leading to increased production of inflammatory cytokines in the presence of triggering pathological factors such as atherosclerosis or damage to heart tissue[20]. Elevated levels of IL-1α and IL-1β in elderly patients can also be explained by the functional difference between these two cytokines. IL-1α acts as an alarm cytokine (alarmin) released directly from damaged or necrotic cells 5 , while IL-1β is produced primarily by immune cells following activation of the NLRP3 inflammasome complex[6]. This inflammatory pathway appears to be more active in older adults due to increased age-related inflammatory sensitivity, leading to increased IL-1β production in the presence of disease[20]. In healthy individuals, the age-related difference was limited to IL-1a levels, which were higher in the elderly compared to others. However, IL-1β levels didn't show a significant difference between the two groups. This may be explained by the fact that IL-1α is directly associated with cumulative cellular damage and oxidative stress associated with aging. It can also be released even in the absence of overt disease due to the increased accumulation of senescent cells and their associated senescence-associated secretory phenotype (SASP)[21,22]. Accordingly, the results indicate that elevated IL-1α and IL-1β in patients reflect an active inflammatory response associated with the disease condition, whereas elevated IL-1α only in healthy older adults more likely reflects the effects of aging and cumulative cellular stress than evidence of active pathological inflammation.

CONCLUSION

Patients with atherosclerotic cardiovascular disease showed significantly higher levels of malondialdehyde, oxidized low-density lipoprotein, interleukin-1 alpha, and interleukin-1 beta than healthy controls, with greater elevations generally observed in elderly patients. malondialdehyde and interleukin-1 alpha showed clearer age-related changes, whereas oxidized low-density lipoprotein and interleukin-1 beta were more strongly elevated in diseased elderly individuals. The aging may intensify oxidative stress and inflammatory activity in atherosclerotic cardiovascular disease.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Fatima Raheem Hassan, Hattf Bazool Farhood
Drafting or Revising Critically:	Fatima Raheem Hassan, Hattf Bazool Farhood
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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Original Article

Quality of Life among Women with Spontaneous Abortion

Ahood Ahsan Mahdi[1] and Wafaa Ahmed Ameen[2]

ABSTRACT

Objective: To find out the impact of spontaneous abortion on women's quality of life across the following domains; physical, psychological, social relationship and environment and to identify the association between overall quality of life and women's sociodemographic characteristics

Study Design: Descriptive correlational study

Place and Duration of Study: This study was conducted at the Al-Hilla City, Babylon Governorate, Iraq, from 15th January 2026 to 15th June 2026.

Methodology: One hundred and eighty women who suffered from spontaneous abortion were enrolled.

Results: An overall positive trend as most respondents marked their quality of life as moderate 53.3% and high 46.7%, while none marked it as low. High mean scores for family, friends and marital relationships are an indicator of strong social support and therefore contribute to well-being.

Conclusion: The continuous psychological and physical follow-up care for women after spontaneous abortion to ensure comprehensive recovery.

Key Words: Quality of life, Spontaneous abortion, Miscarriage, Psychosocial well-being.

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INTRODUCTION

Spontaneous abortion, commonly referred to as miscarriage, represents one of the most frequent pregnancies, affecting up to 10-15% of medically recognized pregnancies internationally[1]. Abortion does not only involve physical, mental, social and financial health; it is appropriate to consider how abortion information is explained and the way to improve their quality of life (QoL) after abortion, in every aspect, and develop measures of a support that can respond to the phenotypes[2]. Abortion is a profoundly traumatic event that affects women emotionally, psychologically, and dating. An important dimension affected by abortion is marital relationship[3].

Women who have abortion are seven times more likely to have increased signs of post-traumatic stress disorder (PTSD) compared to women, with the prevalence of PTSD in this population as high as 39%[4]. Stress is a state of mind and framework caused by mental and physical stress in the individual, stress is a nation caused by stress. Stress can be roughly interpreted as similar to fearful pressure and consider the state an individual exhibits against incompatible external stimuli[5]. Quality of life is a term used to describe how well individual needs are met, and to what extent individuals perceive satisfaction or dissatisfaction in various areas of life, including how they report their own levels of pleasure, happiness, and energy[6]. QoL is a multidimensional construct that includes physical, psychological, social, and functional well-being. After spontaneous abortion, the first category of existence can be reduced both in the immediate period (intense grief, pain, fatigue, pollution) and in the long term (persistent mood disorders, dating pressure, reduced existential happiness)[7].

Clinically, the point between women and healthcare providers through abortion are funded for opportunities to assess coping, explore distress, and implement supportive interventions, yet qualitative and quantitative assessments show inconsistent conversations, inadequate records of predictable physical, emotional, and psychological changes[8]. This gap between clinical need and service provision may worsen the QoL trajectory for some women, suggesting that measuring coping methods and quality of life

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concurrently will generate practical evidence to inform training, protocols, and resource allocation[9].

METHODOLOGY

A descriptive correlational study was conducted in two hospitals at Al-Hilla City from 15th January 2026 to 15th June 2026 letter 102 dated 18-1-2026. One hundred and eighty women with spontaneous abortion were enrolled. Data were collected using questionnaire consisting of three parts: sociodemographic data, reproductive information, and the WHOQOL-BREF Scale. QoL was measured using the World Health Organization Quality of Life-BREF (WHOQOL-BREF), developed by the WHO, consisting of four core domains: physical, psychological, social relationships, environmental, measured using a three-point likert scale. The data was analyzed through SPSS-25.

RESULTS

The higher percentage was between 26 and 33 years, with women comprising 44.4%. Most participants having completed primary education (22.8%), while the illiteracy rate was very low (3.9%). The highest unemployment rate was recorded (57.2%), with the largest concentration (59.4%) in urban areas. 66.7% women had no familial relationship with their husbands, confirming that most marriages were between non-relatives (Table No. 1).

Table No. 1: Sociodemographic characteristics of the participants (n=180)

Variable	Category	No.	%
Age (years)	18-25	56	31.1
	26-33	80	44.4
	34-40	44	24.4
Educational Level	Primary	41	22.8
	Reads and writes	36	20.0
	Intermediate	34	18.9
	Preparatory	34	18.9
	Institute, college or above	28	15.6
	Illiterate	7	3.9
Occupational Status	Unemployed	103	57.2
	Employed	68	37.8
	Student	9	5.0
Residential Environment	Urban	107	59.4
	Rural	73	40.6
Degree of Kinship	Foreigner (Non-relative)	120	66.7
	Relative	60	33.3

51.1% women had given birth once or twice, with 55% of them having one or two live births, although a significant proportion (32.8%) had no children. 68.3% reported experiencing one miscarriage, while 31.7% reported recurrent miscarriages. The average gestational age at the time of the current miscarriage was 10-15 weeks (47.2%) (Table No. 2).

Table No. 2: Reproductive history and clinical data of the participants

Variable	Category	No.	%
Gravida	1-2	92	51.1
	3-4	67	37.2
	≥5	21	11.7
Para	1-2	99	55.0
	0	59	32.8
	≥3	22	12.2
Number of Abortions	1	123	68.3
	2	34	18.9
	≥3	23	12.8
Duration since last abortion (months)	1-2	59	32.8
	3-4	74	41.1
	5-6	47	26.1
Age of current abortion (weeks)	< 10	54	30.0
	10-15	85	47.2
	≥16	41	22.8
Blood Group & Rh (wife)	A+	54	30.0
	O+	42	23.3
	AB+	32	17.8
	B+	22	12.2
	O-	11	6.1
	A-	10	5.6
	AB-	7	3.9
	B-	2	1.1
Blood Group & Rh (husband)	A+	61	33.9
	O+	40	22.2
	B+	23	12.8
	AB+	21	11.7
	O-	16	8.9
	A-	14	7.8
	B-	4	2.2
	AB-	1	0.6

The social domain had the highest score with a mean score of 2.58±0.33 and 69.4% of participants in the high range (2.34-3.00), which shows that firm support from the husband, family and friends is important for emotional rehabilitation. The environmental domain (2.44±0.35, high) comes in second, suggesting that safety, stable home life and access to health care are good for most (62.2%) of the cohort. On the other hand, the internal recovery dimensions have a slower progression. The psychological domain, moderate level (74.4%, 2.25±0.23) dominates with the management of trauma and negative emotional triggers still being a mental transition. The physical domain had the lowest mean score (2.06±0.27; moderate), with 82.2% of the respondents falling in the moderate scale and 2.2% in the low scale (Table 3). The recovery from miscarriage is a slower process than the recovery from the medical and somatic aspects, which usually involves less pain,

exhaustion and sleep disturbances, and underscores the need for ongoing somatic and medical care (Table 4).

The most participants reported a moderate (53.3%) to high (46.7%), QoL, with none in the low category, indicating an overall positive trend. Strong social support reflected in high mean scores for family, friends, and marital relationships plays a key role in maintaining well-being. However, physical energy and health-related aspects remain at a moderate level, physical recovery lags behind social and emotional adjustment (Table 5).

Age, education and living environment had no significant effects on quality of life, while employment status and degree of kinship significantly impacted it. QoL was the most common factor (100%), academic background or age may offer some protection after an abortion. The women married to relatives reported a higher quality of life than those married to non-relatives, highlighting the importance of strong family support for recovery and well-being (Table 6).

Table No. 3: Responses of participants regarding QoL items

Item	Always	Sometimes	Rarely	Mean	SD	Assessment
Physical domain						
I have enough energy for activities	64(35.6%)	78(43.3%)	38(21.1%)	2.14	0.74	Moderate
I suffer from health problems	75(41.7%)	68(37.8%)	37(20.6%)	2.21	0.76	Moderate
I can sleep well & comfortably	86(47.8%)	69(38.3%)	25(13.9%)	2.34	0.71	Moderate
Health prevents daily activities	29(16.1%)	78(43.3%)	73(40.6%)	1.76	0.71	Moderate
I feel physically recovered	67(37.2%)	80(44.4%)	33(18.3%)	2.19	0.72	Moderate
Psychological Domain						
I feel satisfied with myself.	87(48.3%)	71(39.4%)	22(12.2%)	2.36	0.69	High
Difficult dealing with negative emotions	41(22.8%)	77(42.8%)	62(34.4%)	1.88	0.75	Moderate
I can adapt to what happened	108(60.0%)	57(31.7%)	15(8.3%)	2.52	0.65	High
I feel sadness/anxiety when remembering	114(63.3%)	49(27.2%)	17(9.4%)	2.54	0.66	High
I am motivated for future goals	145(80.6%)	29(16.1%)	6(3.3%)	2.77	0.49	High
Social domain						
I feel family supports me	129(71.7%)	40(22.2%)	11(6.1%)	2.66	0.59	High
Friends provide emotional support	123(68.3%)	46(25.6%)	11(6.1%)	2.62	0.60	High
I can talk openly without judgment	131(72.8%)	37(20.6%)	12(6.7%)	2.66	0.60	High
Husband relationship became stronger	130(72.2%)	37(20.6%)	13(7.2%)	2.65	0.62	High
Medical staff provided adequate support	87(48.3%)	60(33.3%)	33(18.3%)	2.30	0.76	Moderate
Environmental domain						
Environment provides safety/stability	124(68.9%)	42(23.3%)	14(7.8%)	2.61	0.63	High
Access to health services.	90(50.0%)	59(32.8%)	31(17.2%)	2.33	0.76	Moderate
Satisfied with living conditions	102(56.7%)	54(30.0%)	24(13.3%)	2.43	0.72	High
Sufficient financial resources	84(46.7%)	73(40.6%)	23(12.8%)	2.34	0.69	High
I can easily get help	109(60.6%)	52(28.9%)	19(10.6%)	2.50	0.68	High

Low (1.00-1.66), Moderate (1.67-2.33), High: (2.34-3.00)

Table No. 4: Categorical distribution of quality of life domains

Quality of life domain	Low Level	Moderate Level	High Level
Social Domain	-	55(30.6%)	125(69.4%)
Environmental Domain	-	68(37.8%)	112(62.2%)
Psychological Domain	-	134(74.4%)	46(25.6%)
Physical Domain	4(2.2%)	148(82.2%)	28(15.6%)

Table No. 5: Overall assessment of quality of life

Overall quality of life level	Score range	No.	%	Mean±SD
Low	1-1.66	-	-	47.03±3.41
Moderate	1.67-2.33	96	53.3	
High	2.34-3	84	46.7	

Table No. 6: Relationship between overall quality of life, and sociodemographic characteristics

Variable	Category	Moderate QoL	High QoL	$\chi 2$	p-value
Age (years)	18-25	31(54.4%)	26(45.6%)	0.144	0.931
	26-33	46(52.9%)	41(47.1%)		
	34-40	19(52.8%)	17(47.2%)		
Education	Illiterate	4(57.1%)	3(42.9%)	2.158	0.827
	Reads & Writes	7(46.7%)	8(53.3%)		
	Primary	20(54.1%)	17(45.9%)		
	Intermediate	24(55.8%)	19(44.2%)		
	Preparatory	6(66.7%)	3(33.3%)		
	Inst./College	35(51.5%)	33(48.5%)		
Occupation	Unemployed	82(58.2%)	59(41.8%)	12.185	0.002*
	Student	-	9(100%)		
	Employed	14(46.7%)	16(53.3%)		
Residence	Urban	45(51.1%)	43(48.9%)	0.358	0.549
	Rural	51(55.4%)	41(44.6%)		
Kinship	Relative	21(39.6%)	32(60.4%)	6.223	0.013*
	Foreigner	75(59.1%)	52(40.9%)		

*Significant at $p<0.05$

DISCUSSION

In the present study, majority of women experiencing spontaneous abortion were aged 26-33 years (44.4%), had primary-level education (22.8%), unemployed (57.2%), resided in urban areas (59.4%), and married to non-relatives (66.7%). This result is aligning with Tavoli et al[10] and Iwanowicz-Palus et al[7] reported that most women experiencing spontaneous abortion were within the reproductive age range. Whereas Zheng et al[11] highlighted the role of educational and socioeconomic factors in reproductive health outcomes. Women who aged 26-33 are at the height of their reproductive capacity, making them more likely to experience pregnancy and consequently pregnancy loss. Limited access to preconception health care and reduced health literacy due to unemployment and lower levels of education may lead to poor health outcomes during pregnancy. The findings suggest that both demographic and socioeconomic characteristics may influence women's reproductive experiences.

This study showed that 51.1% women had given birth once or twice, and 55% had one or two living children, while 32.8% had no children. The result is in line with Futakawa et al[12], reported that many of pregnant women were multiparous, indicating the majority of women had experienced one or more previous births before miscarriage. the study found that 68.3% of women experienced one miscarriage, whereas 31.7% reported recurrent miscarriages. This finding is agree with Genovese & McQueen[13] who reported that sporadic miscarriage is substantially more common than recurrent miscarriage, indicating that most women experience a single miscarriage episode, whereas recurrent miscarriages affect a smaller proportion of women. The average gestational age at the time of miscarriage was 10-15 weeks among 47.2% of participants (Table No. 2). This finding is in line with Magnus et al[14], who found that most cases of spontaneous abortions were in the first trimester of pregnancy and before 14 weeks gestation. This study found that A+ was the most common blood group among both wives and husbands, while a considerable proportion of women (16.7%) and husbands (19.4%) were Rh-negative. This finding is consistent with Akogu et al[15], who found that (Rh +ve) blood groups predominated among the pregnant women while (Rh -ve) blood groups formed a smaller but clinically significant proportion.

This study showed that most women reported a moderate 53.3% to high 46.7% quality of life following spontaneous abortion, with no participant scoring in the low range. The social domain achieved the highest mean score (2.58±0.33), with 69.4% of participants classified in the high range. The environmental domain followed (62.2% high). Majority of women 74.4% had a moderate level of QoL in the psychological domain (2.25±0.23) following spontaneous abortion, while the physical domain recorded the lowest mean score (2.06±0.27), with 82.2% of participants in the moderate range. This finding is align with Bolbocean et al[16], reported that health related QoL improves progressively during the year following miscarriage, although women with recurrent pregnancy loss tend to experience lower quality of life scores than those with a single miscarriage. Futakawa et al[12] showed that women had moderate QoL after pregnancy loss and social functioning had a better recovery than physical health. Iwanowicz-Palus et al[7] reported that women after miscarriage generally perceived a satisfactory quality of life and that social support was significantly associated with better QoL outcomes, it is also consistent with results in this study. Support from family, friends, and healthcare providers helps women to cope with the emotional and social consequences of miscarriage. This

result may indicate the important role of social relationships in promoting recovery and well-being after pregnancy loss.

Present study showed that age, educational level, and residential environment had no significant effects on QoL among women with spontaneous abortion (Table No. 6). This finding is consistent with Farren et al[17] and Mutiso et al[18], found that the psychosocial and interpersonal factors were more important to women's health after pregnancy loss than the demographic factors were. The lack of significant differences by age, education, and place of residence may be because miscarriage has a similar emotional impact on women regardless of their demographic characteristics. However, employment status was significantly associated with QoL. This result is align with the study by Di Nallo and Köksal[19], found that the adverse effects of economic insecurity and employment disruption on women's health and well-being. The women who are employed, might have a more positive QoL because of financial security, more social involvement, and better access to medical services. The present study showed that there was a significant relationship between degree of kinship and QoL. This result is consist with Iwanowicz-Palus et al[7], showed that higher levels of perceived social support are associated with better health perception and greater satisfaction with QoL among women following pregnancy loss. The social roles and relational bonds are more powerful determinants of post-abortion QoL than demographic characteristics such as age or educational level.

CONCLUSION

Majority of participants were aged between 26-33 years old with highest unemployment rate, with the largest concentration lived in urban areas. Most of participants having completed primary education level, and the majority of women reported no familial relationship with their husbands (non-consanguineous). A third of participants had no living children, and most losses occurred at 10-15 weeks of gestation. There were no participants who scored in the low QoL category. Most reported moderate to high QoL. Occupational status and the degree of kinship was the only socio-demographic characteristics that having significant association with the quality of life. Women married to relatives reported a higher QoL than those married to non-relatives.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Ahood Ahsan Mahdi, Wafaa Ahmed Ameen
Drafting or Revising Critically:	Ahood Ahsan Mahdi, Wafaa Ahmed Ameen
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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Original Article

Evaluate the Effect of Artesunate and Cisplatin alone and in Combination in Viability and HIF-1α Gene on Prostate Cancer Cell Line and Compare it with the Viability on Normal HECK-293 Cell Line

Ali Abdulmuttaleb Saleh[1], Majid Kadhoom Abass[2] and Rana A. Ghaleb[3]

ABSTRACT

Objective: To evaluate the effect on viability and hypoxia-inducible factor 1-alpha expression in prostate cancer 3 cell line and normal heck cell line of artesunate and cisplatin and comparing their effect alone and in combination

Study Design: Comparative study

Place and Duration of Study: This study was conducted at the Medicine College, Babylon University, Hillah, Iraq, from 1st October 2024 to 31st March 2025.

Methodology: Prostate cancer 3 cell lines and heck-293 cell line cultured in Roswell Park Memorial Institute supplemented with 10% fetal bovine serum and 1% penicillin/streptomycin. Cells maintained in a humidified incubator at 37 °C. Roswell Park Memorial Institute colorimetric assay performed by seeding prostate cancer cell line in 96-well plate at density of (1x10^4) cells/well. Incubated for 24hour then treated with various concentrations of artesunate and cisplatin alone and in combination then after 24 hours incubation treated with 5mg/ml MTT solution and incubated for four hours then add Dimeythyl solution and measured the result by using microplate reader at 570 nm

Results: Artesunate showed significant inhibition at PC3 in one-way Anova $p<0.001$ the IC50 is 148.61 µg/ml and in normal heck cell line IC50 is 946.125 µg/ml the selectivity index is 6.4. artesunate also upregulates the HIF-1α gene of PC3 cell line in low concentration $p<0.001$but reduces this regulation in higher concentration. the IC50 of cisplatin in heck cell line is 501.62 µg/ml and in PC3 cell line is 606.9 µg/ml. cisplatin shows up significant up regulation on HIF-1 gene in all concentration. Combination index shows synergy in low doses $CI < 1$

Conclusion: Artesunate exhibit significant anticancer effect on PC3 cell line and moderate safety profile comparing with cisplatin which is lower potency and safety. artesunate reducing the up regulation of survival gene HIF-1α opposite to cisplatin which up regulates HIF-1α gene in all concentrations

Key Words: Artesunate, Cisplatin, Prostate cancer, Synergy.

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INTRODUCTION

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One of leading malignancy and worldwide spreading cancer is prostate cancer[1]. Which diagnosed in male globally and it considered one of leading cause of mortality in the male because of cancer which considered a public health problem[2]. Prostate cancer is considered a solid malignancy which is developed under hypoxic conditions microenvironment this hypoxic condition considered critically associated with tumor progression[3]. The expression of HIF-1α in Normoxic conditions is considered on of the important factor in resistance of cancer chemotherapeutic[4]. The hypoxia inducible factors specially (HIF-1α) is stabilized by hypoxic microenvironment of the tumor this factor contributes to regulating and control the

genes which responsible for cellular survival and adaptation such as angiogenesis and metastasis[5]. The aggressive characteristics of prostate cancer tumor like metastasis, angiogenesis and the affection of clinical outcome of patient is related with elevation the expression of HIF-1α[6].

One of the principal transcriptional factor which make the prostate cancer cells adapt to hypoxic microenvironment by angiogenesis is HIF-1α and its considerable target to enhance anticancer therapy[7]. Cisplatin is a chemotherapeutic drug which containing platinum its mechanism of action prevents gene transcription by making crosslinks between DNA double strands furthermore its prevent DNA replication and initiate programed cell Lethality[8]. Cisplatin resistance is one of the problem which affect the clinical outcomes HIF-1α is considered a important factor in the cisplatin resistance under hypoxic microenvironment and that leads to increases the survival of cancer cell[9]. Across many type of tumor type a potent anticancer effects have shown by artesunate which is semi-synthetic derivative of artemisinin that can give a synergistic effect when combined with cisplatin to improve anticancer activity[10]. The combination of chemotherapeutics such as cisplatin with artesunate can give a synergistic antitumor by increasing the effectiveness and induction of apoptosis. so the assessment of HIF-1α can give an important information about the survival status of cancer while using the anticancer medication alone and in combination and its present as considerable target[11].

METHODOLOGY

This comparative study was conducted at Medicine College, Babylon University, Hillah, Iraq from 1st October 2024 to 31st March 2025 letter No. 3434/QM/Approval/JSDJNEHU dated September 7, 2024. MTT assay of artesunate in concentration of (1000, 500, 250, 125, 62.5, 31.25) µg/ml. and cisplatin in concentrations of (500, 250, 125, 62.5, 31.25, 15.6) µg/ml on normal heck cell and artesunate in concentrations of (200, 100, 50, 25, 12.5, 6.25) µg/ml and cisplatin in concentration of (500, 250, 125, 62.5, 31.25, 15.6) µg/ml on pc3 cell then a combination of cisplatin in fixed concentration 31.25 µg/ml and Various concentrations of artesunate (200, 100, 50, 25, 12.5, 6.25) µg/ml.

The effect of artesunate in gene HIF-1α on pc3 cell line at concentrations of (6.25, 50, 200) µg/ml, the effect of cisplatin on the same gene in pc3 cell line at concentrations of (31.25, 125, 500) µg/ml and finally in combination of fixed concentrations of Cisplatin 31.25 µg/ml. plus artesunate (6.25, 50, 200) µg/ml

Cell line and cell culture: Prostate cancer (PC3) cell line obtain from LONZA Biologics (slough UK) and normal human cell HECK-293 obtained from (Pasteur Institute of Iran). PC3 and HEK displaced from liquid nitrogen in -196C and culture in culture media RPMI with 10% FBS and 1% penicillin-streptomycin in humidified incubator (5% co2 and 37C), and renew the culture media every 24hr after that add 3ml of trypsin to the flask and leave it for 5 min then shake the flask gently until all cells detached from the flask add 10 ml of culture media to the flask and mixed well with pipet and then take 250 µl and seeded it in each well.

HIF-1A expression: Total RNA isolation from PC3 cells using the FavorPrep™ Blood/Cultured Cell Total RNA Kit according to the instructions of manufacturer. Briefly, cells were harvested and lysed using FARB buffer containing β-mercaptoethanol, followed by mechanical disruption with acid-washed glass beads. The lysate was centrifuged and mixed with 70% RNase-free ethanol, then applied to a FARB Mini Column. The column was washed with the provided buffers and treated with DNase I to remove genomic DNA contamination.

RESULTS

In the MTT viability assay, artesunate significantly inhibited normal HEK-293 cells ($P<0.001$, one-way ANOVA). At 1000 ($P<0.001$), 500 µg/ml, and 250 µg/ml ($P<0.01$) by t-test, the IC50 is 946.125 µg/ml (Table 1). Cisplatin shows significant cytotoxicity in one-way ANOVA ($p<0.001$), at 500 µg/ml ($p<0.001$) and 250 µg/ml ($p<0.001$) by t-test. The inhibitory concentration 50% of cisplatin in normal HEK-293 cells was 501.62 µg/ml (Table 2). In the PC3 cell line, artesunate also shows a significant anticancer effect ($p<0.001$ in one-way ANOVA), at concentrations of 200 µg/ml, 100 µg/ml ($p<0.001$), and 50 µg/ml ($p<0.05$) by t-test (Table 3). The IC50 of artesunate on the PC3 cell line is 148.61 µg/ml. Cisplatin has significant anticancer activity on the PC3 cell line, with one-way ANOVA $p<0.001$. At concentrations of (500, 250, 125, 62.5) µg/ml, $p<0.001$, and at 31.25 µg/ml $p<0.01$ by t-test and the 50% inhibition concentration is 606.9 µg/ml (Table 4).

For the combination of fixed concentrations of cisplatin 31.25µg/ml and different concentrations of artesunate, the one-way ANOVA revealed a significant effect of the combination on the PC3 cell line ($p<0.0001$). At 31.25µg/ml cisplatin and (200, 100, 50, 25, 6.25)µg/ml of artesunate ($p<0.0001$) by t-Test (Table 5) and the inhibitory concentration 50% of the combination is 243.93 µg/ml (Fig. 1). Combination index shows synergistic effect in concentration of artesunate (6.25, 12.5, 25, 50) µg/ml plus 31.25 µg/ml cisplatin and in 100, 200 µg/ml shows antagonism (Table 6). The selectivity index of artesunate is 6.4

GAPDH is the housekeeping gene used as a negative control in HIF-1α expression evaluation. Cisplatin elevated HIF-1α gene expression at three concentrations (31.25, 125, 500) µg/ml, significantly ($p<0.0001$) in one-way ANOVA (Fig. 2)

Table No. 1: Effect of artesunate on viability of HEK-297

Concentration of Artesunate µg/ml	Viability	Inhibition	P value
31.25	90.49429658	9.505703422	P>0.05
62.5	91.12801014	8.871989861	P>0.05
125	92.90240811	7.097591888	P>0.05
250	77.94676806	22.05323194	P<0.01
500	68.56780735	31.43219265	P<0.01
1000	48.79594423	51.20405577	P<0.001

Table No. 2: Effect of cisplatin on viability of HEK-297

Concentration of Cisplatin µg/ml	Viability	Inhibition	P value
15.6	94.67680608	5.323193916	P>0.05
31.25	91.63498099	8.365019011	P>0.05
62.5	99.23954373	0.760456274	P>0.05
125	90.87452471	9.125475285	P>0.05
250	73.63751584	26.36248416	P<0.01
500	49.42965779	50.57034221	P<0.001

Table No. 3: Effect of artesunate on viability of PC3

Concentration of Artesunate µg/ml	Viability	Inhibition	P value
6.25	93.90846923	6.09	P>0.05
12.5	83.36664913	16.63335087	P>0.05
25	75.47606523	24.52393477	P>0.05
50	70.36296686	29.63703314	P<0.05
100	52.75118359	47.24881641	P<0.001
200	43.02998422	56.97001578	P<0.001

Table No. 4: Effect of cisplatin on viability of PC3

Concentration of cisplatin µg/ml	Viability	Inhibition	P value
15.6	109.6685955	-9.668595476	P>0.05
31.25	78.21146765	21.78853235	P<0.01
62.5	69.56338769	30.43661231	P<0.001
125	59.92635455	40.07364545	P<0.001
250	58.74802735	41.25197265	P<0.001
500	57.06470279	42.93529721	P<0.001

Table No. 5: Effect of combination of fixed 31.25 µg/ml cisplatin plus different concentrations of artesunate

Different concentrations of artesunate µg/ml plus 31.25 µg/ml cisplatin	Viability	Inhibition	P value
6.25	51.5704315	48.42956853	P<0.001
12.5	61.3420051	38.65799492	P<0.01
25	59.9143401	40.0856599	P<0.001
50	60.3743655	39.62563452	P<0.001
100	63.3248731	36.6751269	P<0.001
200	47.5412437	52.45875635	P<0.001

Table No. 6: Combination index value of interaction between artesunate and cisplatin in PC3 cell line

Artesunate concentration (µg/ml)	31.25 µg/ml cisplatin	Inhibition	Combination index	Result
6.25	31.25	48.42956853	0.1	Synergistic
12.5	31.25	38.65799	0.234	Synergistic
25	31.25	40.0856599	0.325	Synergistic
50	31.25	39.62563	0.58	Synergistic
100	31.25	36.67513	1.21	Antagonism
200	31.25	52.45876	1.32	Antagonism

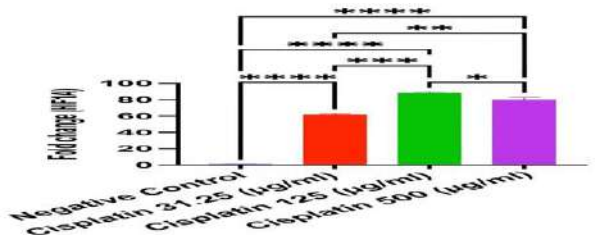


Figure No. 1: Cisplatin in Different Concentrations Effect on Regulation of HIF-1α on PC3 cells (*=p<0.05), (=p<0.01),(***=p<0.001)**

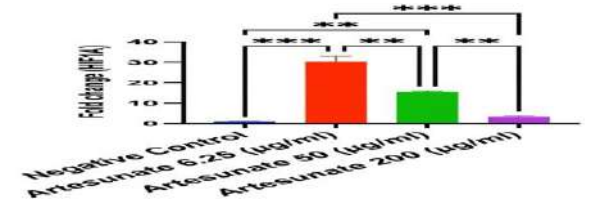


Figure No. 2: Artesunate in Different Concentrations Effect on Regulation of HIF-1α on PC3 cells (*=p<0.05), (=p<0.01),(***=p<0.001).**

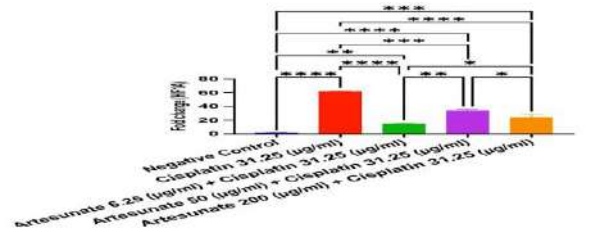


Figure No. 3: Effect of Combination of Different Concentrations of Artesunate with Fixed Concentration of Cisplatin on HIF-1α Gene Expression in PC3 Cell Line (*=p<0.05), (=p<0.01),(***=p<0.001)**

Artesunate elevated HIF-1α gene expression at three concentrations (6.25, 50, 200) µg/ml, significantly ($p<0.0001$) in one-way ANOVA and in Tukey's multiple comparisons ($p<0.0001$) in 6.25µg/ml, ($p<0.001$) at 50 µg/ml, and not significant in concentration of 200µg/ml (Fig. 3).

The combination of fixed concentrations of Cisplatin (31.25) µg/ml and three concentration of artesunate (31.25, 125, 500) µg/ml affecting the HIF-1α expression elevated its regulation significantly $p<0.0001$ in one-way Anova and in Tukey's multiple comparisons ($p<0.01$) in concentration (31.25 µg/ml cisplatin plus 6.25 µg/ml artesunate), in concentration of (31.25µg/ml cisplatin plus 50µg/ml artesunate) $p<0.0001$and in concentration of (31.25 µg/ml cisplatin plus 200 µg/ml artesunate) $p<0.001$.

DISCUSSION

Artesunate shows dose dependent inhibition on pc3 cell line were IC50 148.61µg/ml which is much less effect compared with its effect on normal heck cell which IC50 946.125 µg/ml. The calculated selectivity index (SI) was 6.4 which indicates its toxic to pc3 more than 6-fold than its toxicity on normal heck cell and wide therapeutic window. The selectivity of artesunate to pc3 cell line is because of high iron concentration in pc3 in comparison to normal cell[12], its main cause of cell death because of ferroptosis due to cleavage of endoperoxides bridge in presence of iron and produces reactive oxygen species which kills the cell.[13] Artesunate up regulate HIF-1α expression significantly in low concentration because of ORS (Reactive Oxygen Species) activity[14] and that regulation start to decrease with increasing concentration because the effect of artesunate that decrease the production of HIF-1[15].

The cisplatin IC50 on normal heck cell is 501.62 µg/ml which is lower than its IC50 606.9 µg/ml on pc3 cell which indicate highly toxic effect of cisplatin on normal cell and Probable resistance of pc3 cell to cisplatin[16]. This toxicity of cisplatin came from nonselective interaction to DNA between normal cell and pc3 cell[17]. Cisplatin also elevate the expression of HIF-1α due to its role in increasing the oxidative stress which leads to cell death in addition to DNA adduct process[18].

In combination there is a significant inhibition effect due to synergistic (CI<1) effect of fixed concentration of cisplatin 31.25 µg/ml and the first four dose of artesunate as shown in Table No. 1 The combination upregulate expression of HIF-1α gene but in lesser extants as in cisplatin due to the effect of artesunate of HIF-1α as previously explain.

CONCLUSION

Artesunate exhibits anticancer activity with moderate selectivity furthermore its decrease expression of the survival gene HIF-1α which is advantage over cisplatin in case of potency, safety and HIF-1α gene upregulation. The combination shows synergistic effect in low doses which encourage further study to use the combination as anticancer therapy.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Ali Abdulmuttaleb Saleh, Majid Kadhoom Abass
Drafting or Revising Critically:	Ali Abdulmuttaleb Saleh, Rana A. Ghaleb
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

Conflict of Interest: The study has no conflict of interest to declare by any author.

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Original Article

Beyond Human Chorionic Gonadotropin: The Role of Growth Differentiation Factor-15 and Insulin-like Growth Factor-binding Protein-7 in the Pathogenesis of Hyperemesis Gravidarum

Aseel Abdulameer Mohammed[1], Amal Muner Mubarak[1] and Rusul Jabbar Tuama[2]

ABSTRACT

Objective: To evaluate the levels of serum growth differentiation factor 15 and insulin-like growth factor binding protein-7 in pregnant women with hyperemesis gravidarum and healthy matched pregnant controls, and their independent and combined discriminatory value

Study Design: Prospective case-control study

Place and Duration of Study: This study was conducted at the Department of Obstetrics and Gynecology, Alzahraa Teaching Hospital, Najaf city, Iraq from May 2026 to July 2026.

Methodology: The study included 60 women who had hyperemesis gravidarum and 60 healthy pregnant controls of similar gestational age (6-16 weeks). To diagnose hyperemesis gravidarum, the patient had to have weight loss ≥5%, ketonuria ≥2+, dehydration and a PUQE-24 score ≥8. Serum growth differentiation factor 15 and insulin-like growth factor binding protein-7 were quantified by sandwich enzyme-linked immunosorbent assay. Diagnostic performance was measured using Receiver Operating Characteristic curve analysis and logistic regression adjusted for gestational age, maternal age, parity and body mass index.

Results: The median value of growth differentiation factor 15 was significantly greater in hyperemesis gravidarum (4,277 pg/mL) than controls (1,785 pg/mL; p<0.001). Median insulin-like growth factor binding protein-7 was also elevated (124.0 vs. 67.5 ng/mL; p<0.001). Growth differentiation factor 15 was positively correlated with the PUQE-24 score (Spearman r=0.58; p<0.001). The combined growth differentiation factor 15 + insulin-like growth factor binding protein-7 adjusted model achieved AUC=0.949 (95% CI: 0.897-0.987). There was no significant difference between groups (p=0.34) for serum human chorionic gonadotropin.

Conclusion: The levels of growth differentiation factor 15 and insulin-like growth factor binding protein-7 are significantly higher in HG and show good combined diagnostic accuracy. The absence of a difference in serum human chorionic gonadotropin between groups corroborates the finding that growth differentiation factor 15, instead of human chorionic gonadotropin, is the more important hormone involved in hyperemesis gravidarum.

Key Words: H yperemesis gravidarum, Biomarker, First trimester**,** Human chorionic gonadotropin.

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INTRODUCTION

Hyperemesis gravidarum (HG) represents the most life-threatening manifestation of nausea and vomiting in pregnancy, affecting 0.3-2% of all pregnancies, and is the most common indication for early hospital admission in high-income countries[1]. The 2021 FIGO consensus definition of HG includes severe nausea and/or vomiting starting before 16 weeks of gestation with inability to consume normal food and/or fluids, leading to marked restriction in daily functioning[2]. HG is characterized by intractable vomiting, loss of 5% or more of body weight[3], dehydration, and electrolyte disturbances, and is accompanied by maternal complications such as Wernicke's encephalopathy, central pontine myelinolysis and mental illness[4], as well

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as fetal complications including low birth weight, small-for-gestational-age, premature delivery, and increased neonatal intensive care admission[5]. It shows well-known familial clustering, with a 55% recurrence risk in subsequent pregnancies, suggesting high heritability[6].

Diagnosis of HG is clinical, based on excluding other causes of first-trimester vomiting such as urinary tract infection, thyroid disease, gastroenteritis and cholecystitis[1]. PUQE-24 is a validated scoring system that quantifies nausea, vomiting and retching over a 24-hour period; a score above 7 defines moderate-to-severe NVP[7]. Treatment includes antihistamines (H1 receptor antagonists), phenothiazines, and in refractory cases the serotonin (5-HT3) antagonist ondansetron[8]. Poor responders require intravenous rehydration, electrolyte correction, and thiamine supplementation to prevent Wernicke's encephalopathy[9,10].

For many years the pathophysiology of HG remained poorly understood; older hypotheses centered on elevated hCG or psychosomatic causes failed to explain the disease's severity and variability[11]. A major paradigm shift occurred when a landmark 2018 genome-wide association study by Fejzo and colleagues[12] identified two independent genetic risk loci specifically linked to HG susceptibility: GDF15, located on chromosome 19p13.11, and IGFBP7, located on chromosome 4q12.

This GWAS was performed in a large 23andMe cohort, and the GDF15 association ($p=2.47\times10^{-47}$) was confirmed by meta-analysis and replicated in a Norwegian cohort[12]. Whole-exome sequencing of 926 HG cases subsequently identified a common GDF15 coding variant (H6D substitution, rs1058587), correlated with higher serum GDF15 and lower body weight and BMI, as the only variant found to be significant across the entire exome ($p=9.98\times10^{-11}$)[13]. The largest GWAS meta-analysis to date (8,960 cases with HG; 369,843 controls) confirmed GDF15 as the leading risk locus in the pathway, while also identifying GFRAL as a linked gene ($p=8.85\times10^{-9}$)[12]).

GDF15 itself is a stress-inducible, homodimeric (25 kDa) cytokine, a distantly related member of the TGF superfamily, with normal serum levels of 150-1,200 pg/mL that increase significantly during pregnancy, with high expression in placental trophoblasts[14]. GFRAL, the specific high-affinity receptor for GDF15, is almost exclusively expressed in neurons of the area postrema and nucleus tractus solitarius (NTS) of the hindbrain, which form the chemoreceptor trigger zone of emesis. To create a functional signaling complex, GFRAL must engage the co-receptor RET tyrosine kinase to activate PI3K/AKT, MEK/ERK and PLC/PKC signaling, mediating nausea, vomiting, decreased appetite and aversive conditioned responses[15].

A pivotal 2024 study by Fejzo et al[16] showed that the vast majority of circulating GDF15 in early pregnancy is produced in the feto-placental unit, and that pre-pregnancy GDF15 levels dictate receptor sensitisation: women with lower pre-pregnancy GDF15 show the greatest receptor sensitisation and highest HG susceptibility. In contrast, patients with chronically high pre-pregnancy GDF15 concentrations, such as those with beta-thalassemia, exhibit receptor desensitization and are largely protected against severe HG.

IGFBP7 encodes a protein of the IGFBP superfamily with low affinity for insulin-like growth factors but high affinity for insulin; it is highly induced after embryo implantation, where it regulates uterine receptivity and influences trophoblast invasion by modulating Th1/Th2 cytokines[17]. Serum IGFBP7 correlates with placental functional activity[18], and its concurrent up-regulation with GDF15 in early pregnancy and in HG patients indicates that both are transcriptionally controlled in the placenta. The precise mechanism by which IGFBP7 contributes to emesis, whether through IGF axis dysregulation, IGF-independent appetite-suppressive effects, or synergistic potentiation of GDF15-GFRAL signaling, remains to be fully elucidated[16].

Fejzo et al. compared sera from clinically diagnosed HG women with two control groups (NVP and no NVP) at 12 and 24 weeks' gestation; both GDF15 and IGFBP7, but not hCG, were significantly higher in the HG group at 12 weeks, with differences no longer apparent once symptoms resolved at 24 weeks[16]. Petry et al[19] conducted a nested case-control study within the Cambridge Baby Growth Study (n=791), showing that GDF15 at week 15 was associated with increased risk of vomiting during the second trimester, increased anti-emetic use, and lower pre-pregnancy BMI, consistent with the desensitisation model.

Despite growing evidence for the role of both proteins in HG pathogenesis in Western cohorts, data are limited regarding their effect in Middle Eastern populations, where genetic, metabolic and environmental factors differ; this study was conducted to address this research gap.

METHODOLOGY

This prospective case-control study was conducted at the Department of Obstetrics and Gynecology, Alzahraa Teaching Hospital, Najaf city, Iraq, from May 2026 to July 2026. The inpatient cohort (n=60) comprised women admitted with HG at the sixth to sixteenth week (singleton pregnancy, ultrasound confirmed); diagnosis required weight loss ≥5% of pre-pregnancy body weight, ketonuria ≥2+ on urine dipstick, clinical dehydration (or need for IV fluid therapy), and a PUQE-24 score ≥8. The control group (n=60) comprised healthy pregnant women randomly selected from the antenatal clinic, ±1 gestational week from the corresponding case, with no vomiting or mild

nausea (PUQE-24 ≤6) and no weight loss from pre-pregnancy baseline.

For both groups, exclusion criteria were multiple gestation, gestational trophoblastic disease, pre-existing thyroid or gastrointestinal disorder, urinary tract infection, use of anti-emetics before blood sampling, and refusal of informed consent.

Ten mL of venous blood was drawn from each participant, centrifuged for 10 minutes at 3000 rpm, and serum was frozen at -80°C until batch analysis. Serum GDF15 and IGFBP7 were quantified in duplicate using validated sandwich ELISA kits, acceptable coefficients of variation were <8% (intra-assay) and <10% (inter-assay). All laboratory operators were blinded to clinical status. Contemporaneous results for serum hCG, electrolytes, thyroid function and urinalysis were also recorded.

Data were analyzed statistically using SPSS-26. The Shapiro-Wilk test assessed normality. Normally distributed variables are presented as mean±SD and compared using Student's t-test; non-normally distributed data are presented as median (IQR) and compared using the Mann-Whitney U test. Chi-square or Fisher's exact test was used for categorical variables, and Spearman's rank correlation for relationships between biomarkers. AUCs were compared using the ROC curve with DeLong's method. Independent predictors of HG were identified by logistic regression controlling for gestational age, maternal age, parity and BMI. A p value <0.05 was considered statistically significant.

RESULTS

Overall, the two groups were comparable in gestational age, maternal age and BMI. However, the proportion of primiparous women was greater among cases than controls (60.0% vs. 38.3%, p=0.028); 36.7% of cases, compared with none of the controls, had a prior history of HG (p<0.001). Mean PUQE-24 scores were markedly higher in cases (13.4±2.1 vs. 3.2±1.8; p<0.001); hypokalemia was present in 68.3% of patients, and clinical ketonuria was documented in all 60 cases (100%) [Table 1].

Expression of both GDF15 and IGFBP7 was significantly higher in HG cases than in controls (Table 2, Fig. 1). Median GDF15 was 4,277 pg/mL in cases versus 1,785 pg/mL in controls (p<0.001), a 2.4-fold increase; median IGFBP7 was 124.0 ng/mL versus 67.5 ng/mL (p<0.001). Median serum hCG did not differ significantly between groups (68,240 vs. 61,850 mIU/mL, p=0.34).

The area under the ROC curve and diagnostic accuracy for each biomarker and the combined model are shown in Tables 3-4 and Figure 2; strong diagnostic performance was seen for each biomarker, and the combined model was superior. GDF15 alone achieved AUC=0.913 (95% CI: 0.848-0.967; optimal cut-off 3,576 pg/mL, sensitivity 85.0%, specificity 91.7%). IGFBP7 alone achieved AUC=0.852 (95% CI: 0.774-0.927; optimal cut-off 74 ng/mL, sensitivity 86.7%, specificity 83.3%). After adjustment for gestational age, maternal age, parity and BMI, adjusted AUCs rose to 0.933 (95% CI: 0.875-0.978) for GDF15 and 0.892 (95% CI: 0.827-0.951) for IGFBP7. By DeLong's test, the combined model showed a numerically higher AUC than the adjusted GDF15 model, though not statistically significant (p=0.191), but performed significantly better than the adjusted IGFBP7 model (p=0.012).

Significant positive correlations were found between GDF15 and PUQE-24 scores (r=0.58; p<0.001) and between GDF15 and IGFBP7 (r=0.61; p<0.001); GDF15 correlated negatively with gestational weight change (r=-0.47; p<0.001). Neither GDF15 nor IGFBP7 correlated significantly with serum hCG (Table 5, Figs. 3-4).

Table No. 1: Baseline demographic and clinical characteristics of HG cases and controls

Variable	HG Cases (n=60)	Controls (n=60)	p-value
Gestational age (weeks)	10.2±2.1	10.4±2.0	0.61
Maternal age (years)	27.3±4.8	26.9±4.5	0.63
Pre-pregnancy BMI (kg/m²)	23.8 ± 3.9	24.2 ± 4.1	0.57
Primiparity	36 (60.0%)	23 (38.3%)	0.03
Prior HG history	22 (36.7%)	-	<0.001
PUQE-24 score	13.4±2.1	3.2±1.8	<0.001
Weight loss from pre-pregnancy (%)	7.4±2.3	-	N/A
Serum hCG (mIU/mL), median (IQR)	68,240 (51,200-88,400)	61,850 (47,600-79,300)	0.34
Hypokalemia (K^+ <3.5 mmol/L)	41 (68.3%)	-	<0.001
Ketonuria ≥2+,	60 (100%)	-	<0.001

Table No. 2: Comparison of serum GDF15, IGFBP7 and hCG between HG cases and controls

Variable	HG Cases (n=60)	Controls (n=60)	p-value
GDF15 - Median (IQR), pg/mL	4,277 (3,783-4,562)	1,785 (1,451-1,984)	<0.001
GDF15 - Mean±SD, pg/mL	4,195±891	1,791±498	<0.001
IGFBP7 - Median (IQR), ng/mL	124.0 (95.0-134.3)	67.5 (63.8-71.3)	<0.001
IGFBP7 - Mean±SD, ng/mL	119.8±28.4	67.2±9.6	<0.001
hCG - Median (IQR), mIU/mL	68,240 (51,200-88,400)	61,850 (47,600-79,300)	0.34

Table No. 3: ROC curve analysis: diagnostic performance of GDF15, IGFBP7 and combined model for HG

Biomarker	AUC (95% CI)	Sensitivity (%)	Specificity (%)	Optimal Cut-off
GDF15 alone	0.913 (0.848–0.967)	85.0	91.7	3,576 pg/mL
IGFBP7 alone	0.852 (0.774–0.927)	86.7	81.7	74 ng/mL
Combined model†	0.949 (0.897–0.987)	88.3	85.0	Prob ≥0.65

†Combined model: logistic regression including GDF15 + IGFBP7, adjusted for gestational age, maternal age, parity, and BMI

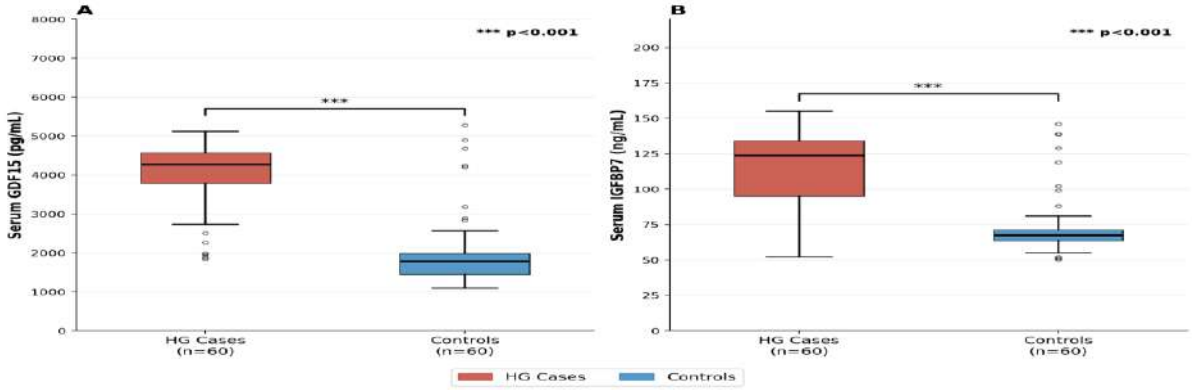


Figure No. 1: Box plots comparing serum GDF15 (A) and IGFBP7 (B) concentrations in HG cases (red) versus healthy pregnant controls (blue). The central line represents the median; box limits represent the 25th–75th percentiles; whiskers extend to 1.5× IQR. *** p<0.001 (Mann-Whitney U test).

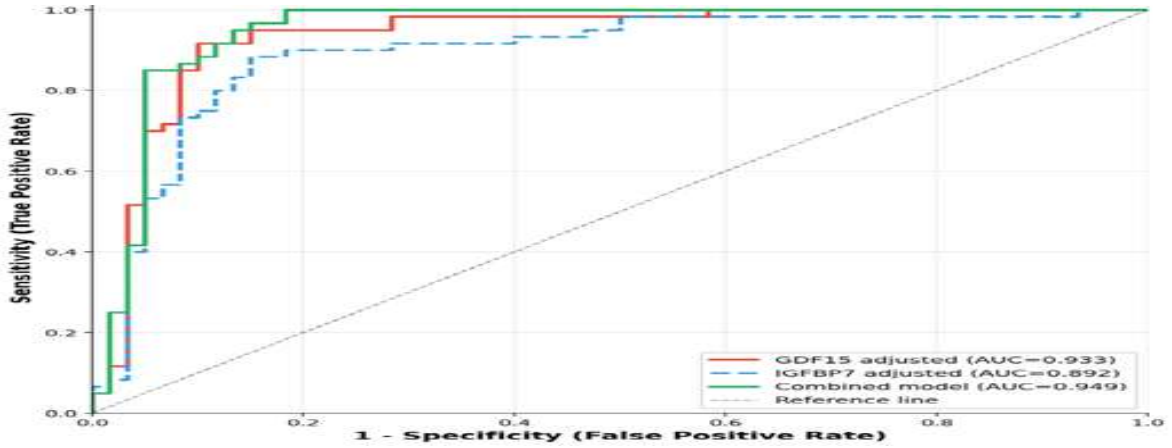


Figure No. 2: Receiver operating characteristic curves for serum GDF15 alone, IGFBP7 alone, and the combined GDF15+IGFBP7 logistic regression model in discriminating HG cases from healthy pregnant controls. AUC values with 95% confidence intervals are shown in the legend.

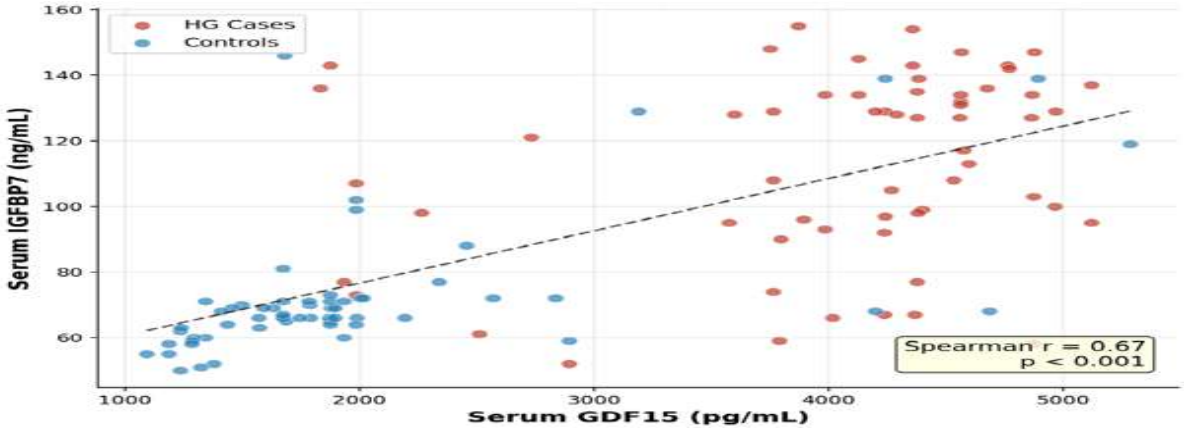


Figure No. 3: Positive correlation between serum GDF15 and PUQE-24 score across all study participants (HG cases: red circles; controls: blue circles). Spearman's r = 0.58, p<0.001

Table No. 4: Multivariable logistic regression: independent predictors of hyperemesis gravidarum

Variable pair	Spearman r	95% CI	p-value
GDF15 vs. PUQE-24 score	0.58	0.43–0.70	<0.001
IGFBP7 vs. PUQE-24 score	0.49	0.33–0.63	<0.001
GDF15 vs. IGFBP7	0.61	0.47–0.73	<0.001
GDF15 vs. gestational weight change	-0.47	-0.61 to -0.31	<0.001
GDF15 vs. serum hCG	0.12	-0.06 to 0.30	0.18
IGFBP7 vs. serum hCG	0.09	-0.09 to 0.27	0.32

All correlations assessed by Spearman's rank correlation coefficient. r = Spearman's rho

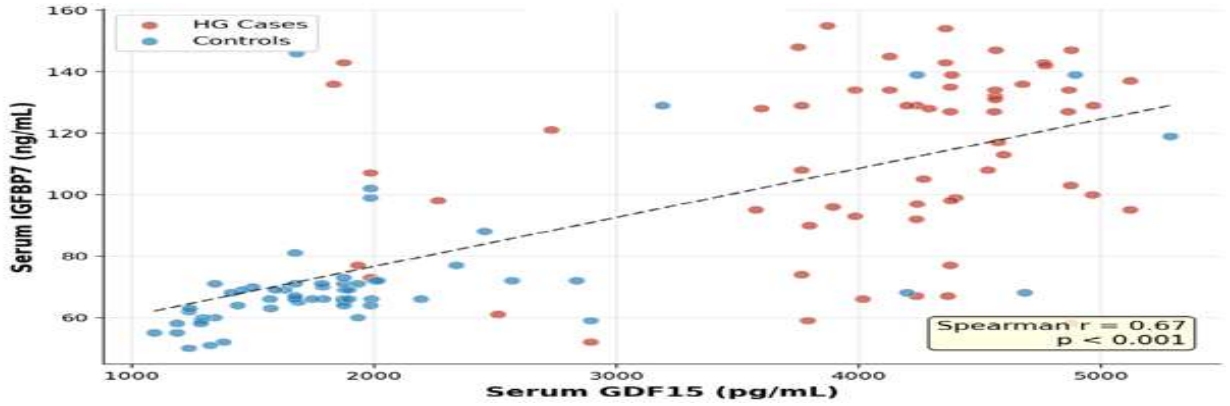


Figure No. 4: Positive correlation between serum GDF15 and IGFBP7 concentrations across all study participants (HG cases: red circles; controls: blue circles). Spearman's r = 0.61, p<0.001

DISCUSSION

This study demonstrates a substantial increase in both serum GDF15 and IGFBP7 during the first trimester in women with HG, consistent with prior clinical findings[16]. The progressive rise in serum GDF15 in early pregnancy was about 2.4-fold higher than controls, with an AUC of 0.913 for GDF15 and 0.852 for IGFBP7, demonstrating clinically useful diagnostic accuracy.

A significant difference in parity was observed between groups, with primiparous women more common among HG cases than controls (60.0% vs. 38.3%, p=0.028). Because parity may influence HG risk[14], it was included as a covariate in the multivariable logistic regression models together with maternal age, gestational age, and BMI. The association between GDF15, IGFBP7, and HG remained significant after adjustment, suggesting the biomarker effects were independent of parity differences.

GDF15 level correlated with PUQE-24 score[20], providing dose-response evidence linking GDF15-GFRAL signaling intensity to clinical symptom severity. This is supported by evidence that increased plasma GDF15 activates area postrema and NTS neurons via the GFRAL-RET pathway[12], and is consistent with the 2024 Nature study linking elevated maternal GDF15 to increased vomiting frequency[1]. GDF15 may therefore serve as both a diagnostic and prognostic marker, guiding treatment intensity, though longitudinal studies are needed to confirm this.

The mechanism by which IGFBP7 causes HG symptoms remains poorly understood and warrants further research. The null finding for serum hCG (p=0.34) directly confirms Fejzo et al[16] and represents an important negative finding that overturns the traditionally accepted hCG hypothesis of HG pathogenesis. Together with the landmark 2024 Nature study[15] and large genetic evidence[12], this favors GDF15, rather than hCG, as the main hormonal driver of HG, with direct implications for clinical care and the development of new therapeutic strategies.

The GDF15-GFRAL axis represents several potential targets for therapeutic intervention. Growing pre-clinical and early clinical evidence shows that antibodies blocking GFRAL can reduce GDF15-induced emesis[2]. The desensitisation hypothesis, whereby low pre-pregnancy GDF15 mimics allergen desensitisation, is supported mechanistically by the observation that women with beta-thalassemia, who have long-term elevated GDF15, experience significantly less NVP[15].

CONCLUSION

A significant increase in serum GDF15 and IGFBP7, positively correlated with clinical severity (PUQE-24 scores), was observed in women with hyperemesis gravidarum during the first trimester. Used together, the two biomarkers achieved greater diagnostic accuracy (AUC=0.949) than either marker alone. The absence of a significant difference in serum hCG levels suggests GDF15 may play a more important role than hCG in HG pathogenesis. These results offer a robust basis for

incorporating GDF15 and IGFBP7 into the clinical evaluation of HG and support development of therapeutic interventions targeting the GDF15-GFRAL axis.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Aseel Abdulameer Mohammed, Amal Muner Mubarak
Drafting or Revising Critically:	Aseel Abdulameer Mohammed, Rusul Jabbar Tuama
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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Original Article

Impact of Fibrinogen-β Chain Polymorphism (rs4220), Plasma Fibrinogen and Thrombin-Antithrombin Complex in Iraqi Patients with Coronary Artery Disease

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ABSTRACT

Objective: To measure the concentration of plasma thrombin-antithrombin complex and fibrinogen, and to analyze the single-nucleotide polymorphism of the fibrinogen B gene (rs4220) in Iraqi coronary artery disease patients and healthy controls

Study Design: Case-control study

Place and Duration of Study: This study was conducted at the Ibn Al-Nafees Hospital, Baghdad Governorate, Iraq, from 1st December 2025 to 28th February 2026.

Methodology: One hundred and twenty participants were enrolled, 40 patients with both diabetes mellitus and coronary artery disease (GI), 40 patients with coronary artery disease only (GII), and 40 apparently healthy controls (GIII). An enzyme-linked immunosorbent assay is used to quantify P. fibrinogen and thrombin-antithrombin complex concentrations. The deoxyribonucleic acid was isolated from blood, followed by polymerase chain reaction amplification using a thermocycler and a newly designed pair of primers targeting the fibrinogen B gene. The Sanger sequencing technique detected the rs4220 single-nucleotide polymorphism.

Results: The highly significant difference in plasma fibrinogen and thrombin-antithrombin complex concentrations compared with controls ($P< 0.01$). The genotypes ($P<0.01$) of the rs4220 single-nucleotide polymorphism in the fibrinogen B gene differed significantly between coronary artery disease patients with diabetes mellitus and controls; no significant difference was observed between the coronary artery disease patients without diabetes mellitus and controls ($P=0.061$). The allele frequencies ($P<0.01$) differed significantly between the G1 and GIII.

Conclusion: The rs4220 polymorphism in the fibrinogen B gene is associated with an increased risk of coronary artery disease and help to assess the genetic risk and inform effective prevention strategies in Iraq.

Key Words: Coronary artery disease, Plasma fibrinogen, Single nucleotide polymorphism, Thrombin-antithrombin complex.

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INTRODUCTION

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The primary cause of infirmity and death in developed countries is coronary artery disease (CAD), and it is associated with approximately 17.8 million deaths yearly worldwide[1]. The pathogenesis of the various complications of CAD, including recurrent myocardial infarction (MI), is attributable to dysfunction of hemostatic function[2]. For preserving blood flow within the circulation, Hemostasis represents the homeostatic system, which seeks to balance between pro-coagulant and anti-coagulant forces[3].

The thrombin-antithrombin complex (TAT) indicates activation of the coagulation cascade and has been related to thrombotic conditions in both venous and arterial systems[4]. TAT complexes are more easily detected than thrombin. Elevated TAT levels have been associated with coronary slow flow and proposed as a diagnostic tool[5].

Plasma fibrinogen is a glycoprotein that is involved in coagulation. The most significant factor contributing to the pathophysiology of atherosclerosis[6]. Elevated levels have been widely linked to multiple CVD-related phenotypes, involving thrombosis, rising blood viscosity, atherosclerosis, and the subsequent development of CAD[7].

A 65-kilobase region on the human chromosome 4 (4q23-q32) contains three genes (FGB, FGG, and FGA) that encode plasma fibrinogen. The greatest focus has been on variations in fibrinogen structural genes,which are explicitly linked to the disruption of fibrinogen[8]. Variations of the fibrinogen β chain (FGB) gene, like rs4220, are associated with increased levels of fibrinogen[9].

The purpose was to measure the plasma levels of TAT Complex and fibrinogen in CAD patients, and to assess the rs4220 polymorphism in the FGB gene in CAD patients and controls to explore the possible effect of this polymorphism of the FGB geneon fibrinogen as early markers of ischemia and improve the management and treatment strategies in Iraqi CAD patients.

METHODOLOGY

The case-control study was conducted at Ibn Al-Nafees Hospital, Baghdad Governorate, Iraq from 1st December 2025 to 28th February 2026 vide letter No. 166 dated 11th July 2025 and included 80 patients with CAD (19 females and 61 males) aged 23 to 86 years and 40 apparently healthy controls with the same age range. Forty samples were collected for each group after ensuring that all the required characteristics within the research plan were 100% matched.

About 5 mL of blood was collected from each subject. The specimens were divided into two aliquots: the first tubes were EDTA tubes containing 2.5 ml of blood, used in the Polymorphism (rs4220) of FGB Gene study. The second tubes are sodium citrate tubes containing 2.5 ml of blood in sodium citrate tubes, and then centrifuged at 1,100 x g for 10 minutes to extract plasma that is used for the measurement study biomarkers by the sandwich ELISA technology based on the procedure protocol of Elabscience® (China) (Catalog No: E-EL-H6106, Catalog No: E-EL-H1788, respectively) by ELISA-Human Reader HS (Human, Germany).

Deoxyribonucleic acid was isolated from 200 µL of blood using the protocols provided by the TransGen DNA extraction kit (China). After extraction, the DNA was used in a PCR assay to amplify the FGB gene at a specific region using a newly designed set of primers from Macrogen, Korea. The forward primer was 5`ACGGTGGTGGATGGTGGTAT3` with 64.1 Tm C and 55% GC content, and the reverse primer was 5'CGTCTGCTTGAGAGTTTTAGAGGAA3` with 60.7 Tm C and 44% GC content. The PCR product was 303 bp. The reaction mixture volume was 27.5 µL, comprising 12.5 µL[2]×EasyTaq® PCR SuperMix, 10 µL of extracted DNA template, 0.5 µL of reverse primer, 0.5 µL of the forward primer, and 4 µL of nuclease-free water. DNA sample amplification was performed using a Thermal cycler device based on the PCR steps, including the initial denaturation step of 5 minutes at 94°C, for only one cycle. The denaturation, annealing, and extension steps take 30 seconds for the 35 cycles at (94°C, 63°C, and 72°C), respectively. The final step is called the final extension step of 8 min at (72°C) for one cycle. The PCR product was visualized using gel electrophoresis (Fig. 1). The PCR product delivered to Macrogen Company in South Korea for Sanger sequencing to detect any sequence variation in a specific region. Chromas Pro (Technelysium Pty. Ltd.) and Jal view are used to analyze and sequence alignments for SNP detection[10].

The data was entered and analyzed through SPSS-26. Chi-square is used to compare percentages. One-way analysis of variance (ANOVA) was used to assess differences among the groups under the study, and post hoc tests were then used for multiple comparisons. Cut-off values, specificity, and sensitivity were estimated by ROC analysis. The Hardy-Weinberg was calculated to examine genotypes and alleles in the gene used.

RESULTS

The mean ages were 56.15±8.145 years in GI, 56.17±14.04 years in GII, and 55.5±8.51 years in GIII, with no statistically significant difference among groups (P=0.877).

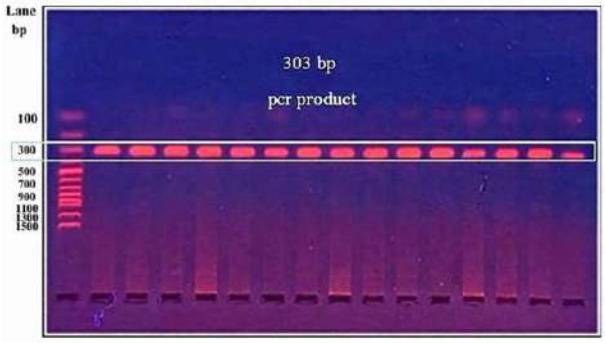


Figure No. 1: Amplification of the FGB gene using 1.5% agarose gel electrophoresis with Gel Stain, 100-1500 bp DNA ladder marks 1-15 resembling a 303 bp PCR product.

Likewise, no significant difference was noted in sex distribution of the patients and controls (χ^2 = 0.80, P=0.670). The mean TAT complex levels differed significantly across GI, GII, and GIII, with the highest values observed in GI, followed by GII and GIII (P<0.01). Similarly, plasma fibrinogen levels were significantly elevated in GI and GII compared to GIII (P<0.01) [Table 1].

Receiver operating characteristic (ROC) analysis was performed to evaluate plasma TAT complex and fibrinogen in GI and GII. In GI, the TAT complex

showed excellent diagnostic performance (AUC = 0.998) with 100% sensitivity and 97.5% specificity at a cut-off value of 359.18 pg/mL, while fibrinogen demonstrated an AUC of 0.966 with 95% sensitivity and specificity at 332.88 ng/mL. In GII, the TAT complex had an AUC of 0.907 with 92.5% sensitivity and 80% specificity at 310.868 pg/mL, whereas fibrinogen showed lower performance (AUC = 0.822), with 90% sensitivity and 75% specificity at 258.55 ng/mL. All results were statistically significant (P = 0.000) [Table 2, Fig. 2].

Table 3 showed the genotype frequencies of the rs4220 polymorphism in the FGB gene among the studied groups. In GI, the genotype distribution was GG (35%), GA (50%), and AA (15%), whereas in GIII it was GG (75%), GA (25%), and AA (0%). A statistically significant difference was observed between GI and GIII (χ^2 = 15.152, P < 0.01). The odds ratio (OR = 3.000) indicated that individuals with the heterozygous genotype (GA) in GI have a threefold higher risk of developing CAD compared to those with homozygous genotypes (GG and AA). All genotype distributions were consistent with Hardy–Weinberg equilibrium. In addition, allele frequencies showed a highly significant difference between GI and GIII (χ^2 = 15.626, P<0.01). For GII, the genotype frequencies were GG (55%), GA (45%), and AA (0%), compared to GIII [GG (75%), GA (25%), AA (0%)]. No statistically significant difference was found between GII and GIII (χ^2 = 3.516, P=0.061). However, the odds ratio (OR = 2.454) suggested that individuals with the GA genotype in GII have a higher risk of CAD compared to those with GG and AA genotypes. Similarly, no significant difference in allele frequency was observed between GII and GIII (χ^2 = 2.771, P=0.072). When comparing GI and GII, the genotype distributions were significantly different (χ^2 = 7.883, P<0.01), with GI showing GG (35%), GA (50%), and AA (15%), and GII showing GG (55%), GA (45%), and AA (0%). The elevated odds ratios (>1) indicated that both heterozygous (GA) and homozygous mutant (AA) genotypes in GI are associated with an increased risk of CAD. Furthermore, allele frequencies differed significantly between GI and GII (χ^2 = 5.072, P=0.013). In this study, GG was considered the wild-type homozygous genotype, GA the heterozygous genotype, and AA the mutant homozygous genotype.

Table No. 1: Mean levels of studied biomarkers among the study groups

Biomarker	GI	GII	GIII	P value
P. TAT (pg/mL)	533.04±31.45	390.34±68.87	284.68±48.7	<0.01(HS)
P. fib. (ng/mL)	397.15±59.36	287.61±31.15	229.23±48.7	<0.01(HS)

HS: Highly significant (P<0.01)

Table No. 2: Receiver operating characteristic curve of the biomarkers in the study groups

Group	Biomarker	Cut-off	AUC	P value	95% CI		Specificity	Sensitivity	PPV	NPV	Youden index
					LB	UB					
GI	P. TAT (pg/mL)	359.18	0.998	0.000**	0.951	1.000	97.5	100	0.97	1	0.925
	P. fib. (ng/mL)	332.88	0.966	0.000**	0.925	1.000	95	95	0.95	0.95	0.9
GII	P. TAT(pg/mL)	310.868	0.907	0.000**	0.822	0.961	80	92.5	0.82	0.91	0.725
	P. fib. (ng/mL)	258.55	0.822	0.000**	0.680	0.896	75	90	0.78	0.88	0.65

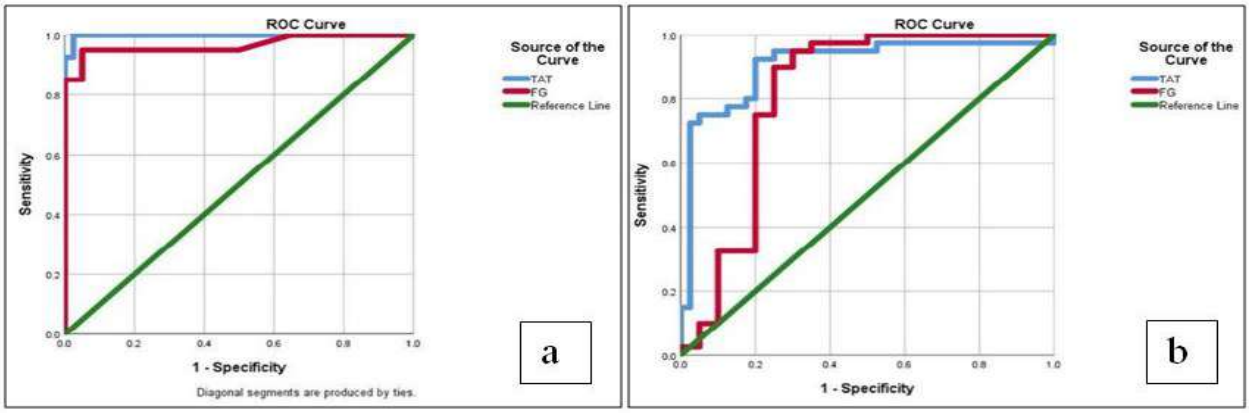


Figure No. 2: Receiver operating characteristic curve for Plasma levels of fibrinogen and TAT complex in the (a) GI group and (b) GII group

Table No. 3: Genotypes and Allele Frequency of rs4220 in the FGB gene in the study groups

Genotype	**GI (n= 40)**	**GIII (n= 40)**	**OR**	**C.I.**	**χ2**	**DF**	**P value**
GG (Homozygous)	14 (35%)	30 (75%)	0.179	0.068 to 0.471	15.152	2	<0.01** (HS)
GA (Heterozygous)	20 (50%)	10 (25%)	3.000	1.164 to 7.732			
AA (Mutant)	6 (15%)	-	15.26	0.829 to 280.73			
Allele	**Frequency**		**Total**				
G	48 (60%)	70 (87.5%)	118 (73.75%)		15.626	1	<0.01**(HS)
A	32 (40%)	10 (12.5%)	42 (26.25%)				
Genotype	**GII (n= 40)**	**GIII (n= 40)**	**OR**	**C.I.**	**χ2**	**DF**	**P value**
GG (Homozygous)	22 (55%)	30 (75%)	0.407	0.157 to 1.052	3.516	1	0.061 (NS)
GA (Heterozygous)	18 (45%)	10 (25%)	2.454	0.95 to 6.339			
AA (Mutant)	-	-	1.000	0.019 to 51.63			
Allele	**Frequency**		**Total**				
G	62(77.5)	70 (87.5)	132 (82.5)		2.771	1	0.072 (NS)
A	18(22.5)	10 (12.5)	18 (17.5)				
Genotype	**GI (n= 40)**	**GII (n= 40)**	**OR**	**C.I.**	**χ2**	**DF**	**P value**
GG (Homozygous)	14 (35%)	22 (55%)	0.440	0.179 to1.083	7.883	2	<0.01** (HS)
GA (Heterozygous)	20 (50%)	18 (45%)	1.222	0.5076 to 2.943			
AA (Mutant)	6 (15%)	-	21.48	1.159 to 398.41			
Allele	**Frequency**		**Total**				
G	48 (60%)	62 (77.5%)	110 (68.75%)		5.072	1	0.013*(S)
A	32 (40%)	18 (22.5%)	(31.25%)				

NS = Not significant *S = Significant **HS = Highly significant

DISCUSSION

In the present study, the mean age of patients was 56.15 years in GI and 56.17 years in GII. CAD is widely recognized as a manifestation of advanced atherosclerosis, predominantly affecting older individuals[11]. The severity and incidence of CAD increase as individuals grow older, with multi-vessel CAD being more common in people over 75 years[12].

This study identified highly significant differences between genders, with males more prevalent than females in the CAD groups. Higher oscillatory conditions in males have been reported in previous studies and are considered a predictor of neointimal thickening, an early stage of atherosclerosis development. This finding suggests that males may be hemodynamically more prone to obstructive vascular lesions than females[13].

Our study results are in line with the results by Su et al[14], which showed an increase in P. fibrinogen levels in CAD patients with or without DM. Fibrinogen encourages atherogenesis by causing low-density lipoprotein (LDL) cholesterol to accumulate in arterial walls[15]. Plasma fibrinogen is known to play a major role in inflammatory response, smooth muscle cell migration, and endothelial dysfunction. Therefore, the relationship of P. fibrinogen levels with CV events and atherosclerosis has long been relevant[16].

Our results are compatible with Valente-Acosta et al[17],

Our results are compatible with Valente-Acosta et al[17], CAD patients have elevated TAT complex levels. TAT complex, a verified indicator of thrombin production, is created when it is rendered inactive by irreversibly attaching to antithrombin. These multifaceted actions underscore its critical role in vascular pathophysiology.[18] Borissoff et al[19] also showed initial stage of atherosclerotic damage presented both significantly higher TAT complex levels and enhanced thrombin production capabilities. Clinical research indicates that increased levels of P. TAT complex are strongly related to the existence and degree of CAD.[20].

In CAD patients who have diabetes, our findings of the rs4220 polymorphisms are consistent with Koch et al[21]. However, our study in CAD patients without DM is in line with the studies by Mallik and Majumder[22]. Standeven et al[23] reported that platelet-rich arterial thrombi, which can induce myocardial infarction, have a heterogeneous fibrin structure affected by fibrinogen levels and FGB gene polymorphisms, the BβArg448Lys fibrinogen variant, along with diabetes, alters fibrin network structure, increasing CV risk. Carriers of the Bβ448Lys variant were younger than Bβ448Arg carriers, indicating a possible association with early mortality in this population[24]. By altering the charge of the molecule, Arg448Lys in FGB may impairthe C-terminal of the B chain in D-domains of the fibrinogen and slightly worsen the condition. It's currently unknown how the Arg448Lys polymorphism affects fibrinogen. According to some earlier research, it is related to P. fibrinogen level and the risk of atherothrombotic disease[25].

CONCLUSION

The individuals with the rs4220 polymorphism in the FGB gene can develop heart diseases with coagulation

defects compared to individuals without this defect; these defects are associated with elevated P. fibrinogen levels, especially in diabetic patients. To date, the variation in this SNP (rs4220) and the level of the thrombin-anti-thrombin complex have not been examined in the Iraqi population.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Zainab Saad Salih, Ahmed Saadi Hassan
Drafting or Revising Critically:	Zainab Saad Salih, Haider Hafudh Humaish
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

Conflict of Interest: The study has no conflict of interest to declare by any author.

Source of Funding: None

Ethical Approval: No.166 Dated 11.07.2025

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Original Article

Assessment of Myocardial Performance Index and Aortic Elastic Properties in Patients with Ankylosing Spondylitis

Zahraa Ayed Al-Hassani[1] and Ali Jaber Al-Maamori[2]

ABSTRACT

Objective: To assess left ventricular myocardial performance and aortic elastic properties in patients with Ankylosing spondylitis

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the Marjan Teaching Hospital's Rheumatology and Echocardiography Units, Babylon, Iraq. from 1st November 2025 to 31st March 2026.

Methodology: There were 60 ankylosing spondylitis patients echocardiography was done for each participant. Myocardial performance index-pulse wave and myocardial performance index-tissue Doppler imaging, aortic strain, distensibility, and stiffness index were assessed by echocardiography. Disease activity was evaluated using Ankylosing Spondylitis Disease Activity Score and C-reactive protein.

Results: Mean aortic stiffness index was 5.9±0.87. myocardial performance index-tissue Doppler imaging correlated positively with aortic stiffness and negatively with distensibility, while Myocardial performance index-pulse wave showed no significant correlations. C-reactive protein-positive patients had higher myocardial performance index values ($p<0.001$). Moderate disease activity was associated with higher myocardial performance index-tissue Doppler imaging ($p=0.020$) and Myocardial performance index-pulse wave ($p=0.012$). Aortic stiffness was the strongest independent predictor of myocardial performance index-tissue Doppler imaging ($\beta=0.453$, $p<0.001$), followed by age ($\beta = 0.296$, $p=0.019$).

Conclusion: Ankylosing spondylitis is associated with subclinical myocardial dysfunction and increased aortic stiffness. myocardial performance index-tissue Doppler imaging may provide a sensitive measure of early cardiovascular involvement.

Key Words: Ankylosing spondylitis, Myocardial performance index, Aortic stiffness, Aortic elastic properties, Echocardiography.

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INTRODUCTION

Ankylosing spondylitis (AS) is a chronic inflammatory disease of the axial skeleton characterized by pain, stiffness, reduced mobility, and vertebral fusion[1]. ASAS established classification criteria for axial and peripheral spondyloarthritis[2], with AS representing radiographic axial spondyloarthritis[3]. HLA-B27 is strongly associated with AS[4], while environmental factors may also contribute to disease development[5].

Cardiovascular involvement is an important extra-articular manifestation associated with increased morbidity and mortality[6]. Cardiac abnormalities occur in approximately 2-10% of patients[7] and include conduction defects, valvular disease, and cardiomyopathy, particularly involving the aortic root, valves, septum, and myocardium[8]. Chronic inflammation contributes to both atherosclerotic and non-atherosclerotic cardiovascular complications[9].

The myocardial performance index (MPI) is a non-invasive measure of global left ventricular systolic and

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diastolic function, derived from conventional Doppler or tissue Doppler imaging using isovolumetric contraction, relaxation, and ejection times[10]. Aortic elasticity can also be assessed non-invasively by echocardiography, with established reference ranges for stiffness, strain, and distensibility[11].

The purpose was to assess myocardial performance and aortic elastic properties to detect subclinical cardiovascular involvement in patients with AS.

METHODOLOGY

This cross-sectional study was conducted in the Echocardiography Laboratory, Echocardiography Department, Mirjan Medical City, Babil Health Directorate, Babylon, Iraq from 1st November 2025 31st March 2026 vide letter No. 124/QM/Approval/dfdfDFVRGd dated January 3, 2025. A total of 60 patients with different sex and age groups who are known case of ankylosing spondylitis were enrolled. Patients aged 20-50 years with established AS were included. Major cardiovascular, metabolic, renal disease, or poor imaging windows were excluded. Age, sex, weight, and medical history were recorded.

LVEF was assessed by M-mode. E/e′ was measured using Doppler and tissue Doppler methods. Left atrial volume was indexed to BSA, while mitral inflow propagation velocity was measured by color M-mode; Vp<50 cm/s indicated impaired relaxation (Fig. 1).

Myocardial Performance Index is a simple and reproducible measure of global ventricular function that does not require precise endocardial border definition. Pulsed-wave MPI was calculated from mitral inflow and LV outflow intervals using the formula MPI = (A-B)/B, where A includes IVCT, IVRT, and ET, and B represents ejection time. A normal MPI is approximately 0.4, while higher values indicate impaired myocardial performance (Fig. 2).

MPI by TDI: Pulsed-wave tissue Doppler imaging was performed in the apical four-chamber view using a 3.5-mm sample volume at the septal and lateral mitral annulus. Ejection time, isovolumetric relaxation time, and isovolumetric contraction time were measured from TDI recordings and used to calculate MPI-TDI (Fig. 3).

The measurement of Ascending aorta diameter was done on M-mode tracing using B-mode based on parasternal long-axis view approximately 3-4 cm above aortic valve as a measure-to-measure aortic stiffness. The diameter was measured on the corresponding electrocardiogram (ECG) at the peak of the QRS in diastole and the maximum anterior movement of the aorta in systole (Fig. 4).

Data were analyzed using IBM SPSS Statistics version 26. Independent t-test, one-way ANOVA, Pearson correlation, and multiple linear regression were applied as appropriate. A p-value <0.05 was considered significant.

RESULTS

Table 1 shows that MPI-TDI correlated positively with aortic stiffness (r = 0.408, p=0.002) and negatively with aortic distensibility (r = −0.299, p=0.020).



Figure No. 1: Measurement of color M-mode mitral inflow propagation velocity(Vp)



Figure No. 2: Measurement of MPI by pulsed-wave Doppler

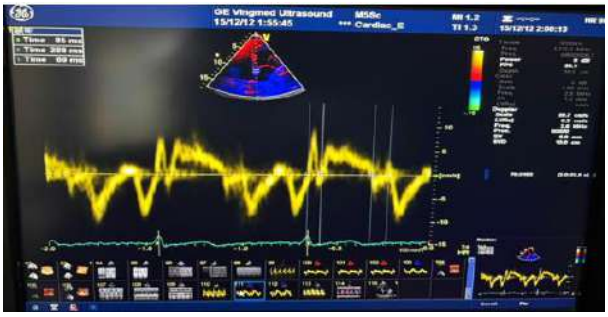


Figure No. 3: Measurement of MPI by TDI

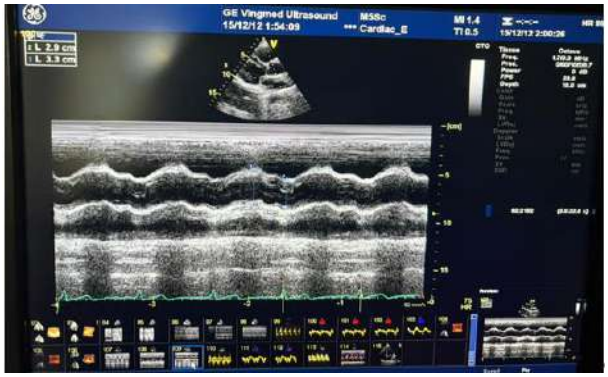


Figure No. 4: Systolic and diastolic diameters measurement of aorta by M-Mode

No significant association was observed with aortic strain. MPI-PW showed no significant correlation with any aortic elasticity parameter. Age had positive correlation with significant difference with myocardial performance ($p<0.05$). Pulse pressure showed a significant positive relationship with aortic rigidity index ($r=0.412$, $p=0.001$). aortic rigidity or myocardial performance were not correlated with BMI, disease duration (Table 2). Table 3 showed CRP had a strong association with MPI-TDI ($p<0.05$) and MPI-PW ($p<0.05$), but not associated with aortic stiffness index suggesting an association between inflammatory activity and myocardial performance alterations.

Table 4 showed the effect of activity of ankylosing spondylitis on myocardial performance, aortic stiffness by using ankylosing spondylitis disease activity score (ASDAS). The table showed non-significant associated between ASDAS and aortic stiffness ($p>0.05$) but significant difference with myocardial performance ($P<0.05$).

Table 5 showed effect of AS duration on degree of aortic regurgitation (AR). There was highly significant association between duration of AS and degree of aortic regurgitation ($p<0001$). Increase of duration lead to increase regurgitation grade; mean duration of patients who had no AR was 4.21±2.62 years while mean duration of patients who had trace AR was 9.17±2.52 years and mean duration of patients who had mild AR was 19.20±5.5 years.

The multivariable model explained 34.5% of MPI-TDI variability ($R^2 = 0.345$; $p<0.001$). Aortic stiffness was the strongest independent predictor ($\beta = 0.453$; $p < 0.001$), followed by age ($\beta = 0.296$; $p = 0.019$), while BMI and disease duration were not significant predictors (Table 6).

Table No. 1: Correlation between MPI and aortic stiffness

Variable	r	P value
MPI TDI		
Aortic stiffness index	0.408	0.002
Aortic distensibility	-0.299	0.020
Aortic strain	0.128	0.332
MPI PW		
Aortic stiffness index	0.174	0.184
Aortic distensibility	-0.080	0.544
Aortic strain	0.027	0.838

Table No. 2: Correlation with baseline characteristics

Variable	MPI TDI r(P)	MPI PW r(P)	Aortic stiffness r (P)
Age	0.34(0.04)	0.32(0.01)	-0.03(0.81)
BMI	-0.16(0.20)	-0.08(0.54)	0.13(0.30)
Disease duration	0.25(0.054)	0.19(0.15)	-0.08(0.51)
Pulse pressure	-0.11(0.38)	-0.15(0.26)	0.412 (0.03)

Table No. 3: Association between CRP and MPI and aortic stiffness

CRP	MPI TDI	MPI PW	Aortic stiffness
Positive	0.59±0.09	0.61±0.20	2.41±1.05
Negative	0.44±0.06	0.39±0.06	2.08±0.70
p-value	<0.001	<0.001	0.146

Table No. 4: Effect of activity of AS on myocardial performance and aortic stiffness

ASDAS	No.	Mean±SD	P value
Aortic stiffness index			
Inactive disease	32	6.2±0.69	0.540
Moderate disease	28	5.6±1.03	
MPI TDI			
Inactive disease	32	0.47±0.07	0.020
Moderate disease	28	0.53±0.13	
MPI PW			
Inactive disease	32	0.43±0.10	0.012
Moderate disease	28	0.53±0.20	

Table No. 5: Effect of duration of disease (years) in AS on degree of aortic regurgitation (AR)

Degree of AR	No.	Mean±SD	P value
None	38	4.21±2.62	<0.001
Trace	12	9.17±2.52	
Mild	10	19.20±5.5	

Table No. 6: Multivariate regression analysis

Variable	B	95% CI	Standardized β	t	P value
Age	0.004	0.001- 0.007	0.296	2.425	0.019
BMI	-0.006	-0.013- 0.001	-0.187	-1.648	0.105
Disease duration	0.002	-0.003-0.007	0.112	0.888	0.379
Aortic stiffness index	0.056	0.029- 0.083	0.453	4.103	<0.001

$R = 0.587$, $R^2 = 0.345$, Adjusted $R^2 = 0.297$, $F = 7.239$, Overall model $P <0.001$

DISCUSSION

This study demonstrated subclinical myocardial dysfunction and impaired aortic elasticity in patients with ankylosing spondylitis (AS). Elevated MPI-TDI despite preserved conventional echocardiographic findings supports its value for detecting early cardiac involvement[12]. Heslinga et al[13] have reported left ventricular diastolic dysfunction in 9-45% of AS patients despite preserved ejection fraction.

Both MPI-TDI and MPI-PW were elevated, indicating impaired global myocardial performance. Chronic

inflammation, including TNF-α-mediated fibrosis and microvascular dysfunction, may contribute to these abnormalities[14]. Similar increases in MPI have been reported by Acar et al[15] and Yildirir et al[16].

C-reactive protein positive patients had higher MPI values, and moderate disease activity was associated with increased MPI-TDI and MPI-PW. These findings support an association between inflammatory activity and myocardial dysfunction[15]. Similar relationships between disease activity and MPI have been reported by Okan et al[17] and Bodakçi et al[18].

Mean Vp was 44.00±5.6 cm/s, suggesting impaired ventricular relaxation despite otherwise preserved diastolic indices[19]. Aortic stiffness was also increased, with reduced distensibility indicating impaired vascular compliance, consistent with previous reports in AS[20].

Aortic stiffness correlated with pulse pressure but not with CRP or ASDAS, suggesting that vascular changes may reflect cumulative rather than current inflammatory activity. MPI-TDI correlated positively with aortic stiffness and negatively with distensibility, whereas MPI-PW showed no significant association, supporting greater sensitivity of MPI-TDI[21].

Aortic regurgitation severity increased significantly with longer disease duration ($p<0.001$), supporting progressive aortic root and valvular involvement in longstanding AS[22].

CONCLUSION

Patients with AS showed subclinical myocardial dysfunction and increased aortic stiffness. MPI-TDI was more sensitive than MPI-PW and independently associated with aortic stiffness. Myocardial impairment was related to inflammatory activity and age, while longer disease duration was associated with greater aortic regurgitation. Combined myocardial and aortic assessment may help detect early cardiovascular involvement in AS.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Zahraa Ayed Al-Hassani, Ali Jaber Al-Maamori
Drafting or Revising Critically:	Zahraa Ayed Al-Hassani, Ali Jaber Al-Maamori
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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Original Article

Maternal Morbid Obesity: Impact on Pregnancy Outcome

Maternal Morbid Obesity

Zainab Abd Alkathem Fatnan[1], Seba Abdulkadhim Fatnan[2] and Shaymaa Raouf Tawfeeq Al-Hasani[1]

ABSTRACT

Objective: To evaluate how morbid obesity among women effects on pregnancy, pregnancy outcome, method of delivery, and postpartum period complications

Study Design: Retrospective study

Place and Duration of Study: This study was conducted at the Al-Zahraa Teaching Hospital, Najaf, Iraq, from 1st February 2024 to 31st December 2024.

Methodology: One hundred females of morbid obesity (BMI ≥40) had singleton deliveries were enrolled. The singleton pregnancy and available values of BMI and complete medical records formed the inclusion factors, and multiple gestations and existing non-related illness formed the exclusion factors. Data about maternal demographics, complications of pregnancy, type of delivery, and outcome of neonates were collected.

Results: Most of the participants belonged to age group 30-34 years. Obese women had the highest frequencies (35% and 40%) of undergoing cesarean sections and emergency cesarean sections, respectively. Pregnancy complications were gestational diabetes 44%, pre-eclampsia 40%, and gestational hypertension 28%. Congenital malformations had an occurrence of 5% with the diagnosis of congenital ventricular septal defects and congenital neural tube Pre-pregnancy BMI had a moderate negative relationship with birth weight ($r = -0.45$, $p<0.01$). Emergency cesarean sections had a significant correlation with increased complications ($p = 0.03$), and the greater the BMI, the lower the birth weight for an emergency.

Conclusion: Pre-conceptional control of maternal morbid obesity necessitates individualized prenatal care and the achievement of optimal pregnancy outcomes. Maternal morbid obesity is linked with increased pregnancy morbidity, increased rate of cesarean sections, and adverse fetal outcomes.

Key Words: Morbid obesity, Pregnancy outcomes, Method of delivery, Complication.

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INTRODUCTION

Maternal obesity, defined as a body mass index (BMI) of ≥30 kg/m^2, is a growing global public health concern, particularly in relations to pregnancy outcomes. The rising prevalence of obesity worldwide poses significant challenges to obstetric care.

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Pregnancy complicated by pregnancy is associated with higher risk of complications such as gestational diabetes hypertensive disorders, prolonged labor and increase cesarean section rate.[1] Obesity is classified based on BMI in to Class I (30-34.9 kg/m^2), Class II (35-39.9 kg/m^2), and Class III (≥40 kg/m^2), also known as morbid obesity. This severe form is associated with significantly increased maternal and neonatal risks[1,2].

Physiological changes during pregnancy induce significant physiological adaptations affecting multiple systems. These include increased cardiac output and blood volume, enhanced respiratory function, elevated renal filtration and metabolic changes such as insulin resistance. These adaptations support fetal growth but may exacerbate complications in obese women[3,4].

Maternal obesity increases the risk of early pregnancy loss due to hormonal imbalance, inflammation and impaired implantation[5]. Morbid obesity is strongly associated with gestational diabetes, hypertensive disorders, and thromboembolic events due to insulin resistance, inflammation, and hypercoagulability[6-9].

Obese women are at higher risk of prolonged labor, cesarean delivery, anesthesia difficulties, and shoulder dystocia, often due to fetal macrosomia. Postpartum risks include hemorrhage, infection, and delayed wound healing. Long-term risks include type 2 diabetes and cardiovascular disease[7-9].

Maternal morbid obesity is linked to adverse outcomes such as stillbirth, congenital anomalies, macrosomia, and increased neonatal intensive care admissions[10-15].

METHODOLOGY

This retrospective cohort study was done at Al-Zahraa Teaching Hospital Najaf, Iraq from 1st February 2024 to 31st December 2024. A total of 100 singleton women who had given birth were recruited. The women had been categorized by BMI, as morbid obesity group (BMI ≥40 kg/m^2). Singleton birth, pre-pregnancy or early pregnancy BMI availability, comprehensive obstetric and neonatal test and examination reports and consent from participants were included. Multiple gestations (twins, triples), pre-existing, non-obesity-related chronic illnesses (e.g., type 1 diabetes mellitus, renal disease) and missing or incomplete records of pregnancy outcome or BMI were excluded. The data of parity, maternal weight, height, and age, pre-conception or booking BMI, pregnancy complications include gestational diabetes, hypertension, preeclampsia, preterm labor etc and neonatal outcome measures, birth weight, NICU admission, Apgar score etc. were recorded. The participants were asked to complete a validated questionnaire post-delivery, which were obesity history and types, pregnancy complications, delivery method and postpartum complications and breastfeeding and long-term health outcomes.

Analysis of the data was done using SPSS-25. Pearson correlation and Chi-square tests were applied. A p-value of <0.05 for all analyses was considered to be statistically significant.

RESULTS

The frequency of age, mode of delivery, pregnancy complications, congenital malformations, mode of delivery and pregnancy complications, morbidly obese and correlation of pre-pregnancy BMI and pregnancy outcome of the study population is represented in Tables 1-7.

Table No. 1: Participants distribution according to ages (n=100)

Age (years)	No.	%
18–24	20	20.0
25–29	18	18.0
30–34	42	42.0
35–39	15	15.0
≥ 40	5	5.0

Table No. 2: Mode of delivery among obese mothers

Mode of Delivery	No.	%
Vaginal Delivery	35	35.0
Cesarean Section	25	25.0
Emergency cesarean section	40	40.0

Table No. 3: Pregnancy complications

Complication	No.	%
Pre-eclampsia	40	40.0
Gestational hypertension	28	28.0
Preterm labor	24	24.0
Fetal growth restriction	20	20.0
Gestational diabetes	44	44.0
Blood clots (DVT, PE)	12	12.0
Infection	14	14.0
Previa	2	2.0
Placenta abruption	2	2.0
Congenital malformations	5	5.0

Table No. 4: Distribution of congenital malformations among participants (n=5)

Category	Specific conditions	No.	%
Cardiac(heart) diseases	Ventricular septal defect (VSD)	1	40.0
	Atrial septal defect (ASD)	1	
Neurological disorders	Neural tube defect (NTD)	1	20.0
Craniofacial anomalies	Cleft lip	1	20.0
Musculoskeletal disorders	Clubfoot	1	20.0

Table No. 5: Mode of delivery and pregnancy complications

Complication	Total Cases	Vaginal Delivery	Cesarean Section
Pre-eclampsia	40 (40%)	5 (12.5%)	12 (30%)
Gestational hypertension	28 (28%)	10 (35.7%)	10 (35.7%)
Preterm labor	24 (24%)	2 (8.3%)	6 (25%)
Fetal growth restriction	20 (20%)	5 (25%)	7 (35%)
Gestational diabetes	44 (44%)	15 (34.1%)	20 (45.5%)
Blood clots (DVT, PE)	12 (12%)	1 (8.3%)	3 (25%)
Infection (e.g., UTI, wound infection)	14 (14%)	5 (35.7%)	6 (42.9%)
Placenta previa	2 (2%)	-	1 (50%)
Placental abruption	2 (2%)	-	-
Congenital malformations	5 (5%)	2 (40%)	3 (60%)

Table No. 6: Impact of conditions on birth weights of pregnant women who are morbidly obese

Subgroup	No.	Mean Birth Weight (kg)	Remarks
Vaginal delivery	35	3.30±0.60	Full-term pregnancies without major complications resulted in higher weights.
Cesarean section	25	3.90±0.40	Scheduled deliveries often involve mild complications, leading to moderate weights.
Emergency cesarean section	40	2.70±0.80	Associated with preterm deliveries or fetal distress, resulting in lower weights

Table No. 7: Correlation of pre-pregnancy BMI and pregnancy outcome

Variable	Statistical Test	Correlation Coefficient (r)	P value	Interpretation
Pre-pregnancy BMI and birth weight	Pearson Correlation	-0.45	< 0.01	Moderate negative correlation; higher BMI associated with lower birth weight.
Mode of delivery and pregnancy complications	Chi-square Test	—	0.03	Significant association; emergency cesarean linked to increased complications.
Maternal age and pregnancy complications	Pearson Correlation	0.12	0.25	Weak positive correlation; not statistically significant.

DISCUSSION

The age group of pregnant women with morbid obesity in the population indicates that the majority of the population falls under the age group of 30-34 years, accounting for 42% of the population (Table 1). This concurs with the work of Wanaditya et al[1], who revealed that pregnant women aged in their thirties have high odds of experiencing pregnancy-related obesity complications, consonant with the larger percentage in this age group. Besides, the women in the age group of 18-24 years (20%) and 25-29 years (18%) do reveal that the young female population suffers from morbid obesity but to a lesser extent. The same finding presented by Lauth et al[2], where the prevalence of obesity increased with the increase of the mother's age, i.e., after the age of 30 years. The lower percentage of women in the 35-39 years (15%) and ≥40 years (5%) age groups support evidence that advanced maternal age, although less common with this population, remains an important risk factor for maternal obesity. Lauth et al[2] also indicated that advanced maternal age is accompanied by increased adiposity, which may contribute to adverse obstetric outcomes.

The findings of this study reveal that among the obese expectant women, 35% delivered vaginally, 25% delivered through elective cesarean sections, and a notable 40% had emergency cesarean sections. This high rate of cesarean sections, especially emergency cesarean sections, concurs with Wanaditya et al[1]. Obesity has played a significant part in rising the rate of cesarean sections because of such indications as dystocia during labor and fetal macrosomia.

Similarly, Khalifa et al[11] emphasized that BMI during pregnancy is a strong predictor for the rate of cesarean sections, and that obese women are more likely to receive the procedure compared to women of normal weights.

The high percentage (40%) of our population receiving emergency cesarean sections can be attributed to the labor issues of obesity such as failure to progress and fetal distress that have been well documented in the literature[2,11].

Also, Lauth et al[2] emphasized that maternal obesity extends the duration of labor and increases the rate of operative deliveries, including emergency cesarean sections.

Additionally, the study revealed that 25% of morbidly obese pregnant women (25 out of 100) required admission to the intensive care unit (ICU) either during labor or in the immediate postpartum period. This was primarily due to severe complications such as uncontrolled pre-eclampsia, respiratory compromise, or hemodynamic instability. In this study, the highest prevalence of gestational diabetes mellitus (44%) and pre-eclampsia (40%) were identified in the complicated pregnancies of obese pregnant women, followed by gestational hypertension (28%) and preterm labor (24%). These findings support Wanaditya et al[1] that obesity enhances the rate of gestational diabetes and pre-eclampsia, which are two of the main maternal morbidity reasons for the obese patients.

In addition, Khalifa et al[11] established that obese women have a greater chance of the development of hypertensive conditions such as pre-eclampsia and gestational hypertension, perhaps because of increased adiposity-linked inflammation and endothelial dysfunction (22%). The high prevalence of gestational diabetes (44%) supports the findings of Melchor et al[13], where they established that obesity represented the

main risk for glucose intolerance in pregnancy, which ended in adverse perinatal outcomes.

Moreover, the 20% rate of fetal growth restriction and the 24% rate of prematurity confirm all the evidence collected that fetal growth and place associated with vascular abnormalities of the placenta that can impair fetal growth and prematurity susceptibility[3]. The relatively low rate of venous thromboembolism (12%) and infection (14%) findings are supported by studies proving increased thrombotic and infection risks for the pregnant woman who is obese[6,8].

The congenital defects among the study participants were prevalent, and both the ASD and the VSD accounted for 40% each, followed by the NTDs for 20%, the cleft lip for 20%, and the clubfoot for 20%. This agrees with the work of Wanaditya et al[1]. that maternal obesity raises the rate of congenital heart abnormalities, including the ASD and the VSD, because of the alteration of the intrauterine metabolic and inflammatory milieus.

Similarly, Melchor et al[13] found that neural tube defects were more prevalent in babies whose mothers were pregnant and had obesity, possibly because of interference with the metabolism of folate and with pregnancy hyperglycemia. Obesity of pregnancy's increased susceptibility to craniofacial defects such as cleft lip and skeletal defects such as clubfoot has also been established, most probably because of dietary deficiencies and vascular adaptations in the course of fetal development[2,12].

The mode of delivery in morbidly obese pregnant women was predominantly a cesarean operation (60%) compared to vaginal (40%), with the majority of emergency cesarean deliveries being attributed to pre-eclampsia, preterm labor, blood clot, and infection. Pre-eclampsia especially had an emergency rate of 57.5% cesarean, indicating the major impact of this condition on the mode of delivery. These findings are reinforced by findings of Shagana et al[3] and Chandra & Paray[4] indicating that maternal obesity leads to increased risks of cesarean delivery, which itself tends to arise from obstetrical complications such as hypertensive complications and fetal distress. Wanaditya et al[1] also indicated that the rate of pre-eclampsia in the population of obese women is greater and they require greater operative intervention, including emergency cesarean sections, due to adverse maternal and fetal status. Similarly, Lauth et al[2] highlighted that fetal growth restriction and hypertension complicated pregnancies are major reasons for the performance of the cesarean section during pregnancy and typically performed as emergents. The greater rate of delivery by the cesarean birth method in fetal growth restriction and preterm labor also supports that metabolic and vascular derangement of obesity makes one susceptible to fetal compromise with the resultant increase in obstetric intervention[2,5].

Added to this, blood clotting (DVT, PE) and infection with emergency cesareans (66.7% and 21.4%, respectively) occurrence conform with studies, the prothrombotic and immunosuppressed conditions of the obese mother that increase the risks of obstetrical emergencies that will require urgent operative intervention[15]. The high level of congenital malformations, though small, conforms with the impact of metabolic impairments of obesity on fetal growth[13].

Full-term vaginal deliveries had averages of 3.30±0.60 kg, indicative of normal fetal growth in uncomplicated pregnancies. Planned cesarean deliveries, however, had a greater average of 3.90±0.40 kg, an observation for which the obstetrician's practice of performing the planned cesarean on the obese with mildly complicated pregnancies or with the estimated macrosomia can provide an explanation supported by previous studies that maternal obesity favors greater fetal growth and cesarean delivery[2,10].

Conversely, the emergency C-sections resulted in a significantly lower birth weight of 2.70±0.80 kg. This reduction may be an indication of the increased rate of preterm labor, fetal distress, or intrauterine growth restriction (IUGR) in themother's obesity-linked gestational diabetes and pre-eclampsia, which inhibits fetal growth[2,4]. Wanaditya et al[1] reported that emergencies consist of preterm or compromised fetuses, thus the lower birth weights. Preterm labor and fetal distress, common during obesogenic pregnancies, result in premature delivery with lower weights[8].

The current study also demonstrated a negative correlation between birth weight and pre-pregnancy BMI, in that greater maternal BMI is correlated with lower neonatal birth weights among morbidly obese mothers. The reverse correlation agrees with evidence that greater pre-pregnancy BMI may lead to fetal growth restriction either by a process of placental insufficiency or metabolic derangements of obesity[3,10]. While obesity tends to be associated with macrosomia, in morbid obesity the effect on the placenta is harmful, inducing intrauterine growth retardation, especially with complicated pregnancies[2].

Also, there existed a significant relationship between the mode of delivery and pregnancy complications, with emergency cesarean being significantly related with an increase in pregnancy complications such as pre-eclampsia, preterm labor and fetal distress. The findings concur with the studies that establish that maternal obesity is linked with an increase in obstetric emergencies that call for emergency surgery[2,4]. Wanaditya et al[1] had stated that intrapartum complications that call for emergency cesarean delivery were common among women who were obese, and this could clearly be seen from the significant relationship that existed in this study.

Interestingly, maternal age was weakly, but not significantly, related to pregnancy complications,

showing that maternal age under these conditions was not a significant determinant of pregnancy outcomes, consistent with previous work highlighting that the metabolic status that exists before pregnancy and related BMI are the significant determinants, not age itself[4].

CONCLUSION

The age is well represented among pregnant obese women and a greater rate of cesarean sections, including emergency copes, indicating that being obese raises the probability of having surgery during the birth process. Obese women have an elevated pregnancy risk of complicated pregnancies involving gestational diabetes, hypertensive conditions, and preterm labour, indicating the enhanced obstetric risks posed by maternal obesity. There have been small but significant numbers of congenital malformations described, with probable associations of fetal developmental anomalies with maternal obesity. Maternal pre-pregnancy BMI is inversely related moderately to birth weights, and emergency cesarean delivery is very strongly linked with increased complication rates and low birth weights, particularly in the case of preterm or compromised fetuses. Higher maternal BMI is linked with adverse pregnancy outcomes, enhanced complications, and altered fetal health parameters. Morbid obesity has a much greater rate of postpartum complications, which indicates that post-delivery health complications and recovery of the mother persist and are significant.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Zainab Abd Alkathem Fatnan, Seba Abdulkadhim Fatnan
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Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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Original Article

Evaluation of the Impact of Rosemary Oil on Specific Properties of 3D-Printed Acrylic Resin Material

Tameem Khuder Jassim[1], Alaa Hussein Jasim[2], Shaymaa Majid Abdulhameed[3], Issam Ahmed Mohammed[4] and Samir Samier[5]

ABSTRACT

Objective: To assess the impact of rosemary oil concentrations (1%, 2%, 3%) on the surface roughness and hardness of 3 dimensional-printed acrylic resin

Study Design: Descriptive study

Place and Duration of Study: This study was conducted at the College of Dentistry, Mustansiriyah University, Iraq, from 1st February 2026 to 31st March 2026.

Methodology: 32 bar-shaped samples with dimensions of (65x10x2.5 mm) length, width, and thickness, which were separated into four main groups (Control group, Group 1%, Group 2%, and Group 3%) based on the concentration of rosemary oil addition.

Results: The surface roughness test had the highest mean value 1.911 after adding 1% rosemary oil, and the lowest mean value 0.883 after adding 2% rosemary oil. The results also showed that the maximum mean value of the surface hardness test was 79.525 after adding 1% rosemary oil, while the lowest mean value was 76.475 after adding 2% rosemary oil.

Conclusion: The addition of rosemary oil at selected concentrations improved the surface characteristics of 3 dimensional-printed acrylic resins by increasing hardness and reducing roughness.

Key Words: Three dimensional-printed acrylic resin, Rosemary oil, Surface roughness. Surface hardness.

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INTRODUCTION

Three-dimensional (3D) printing technology allows the production of complex dental structures with a high level of precision that is difficult to achieve using conventional manufacturing techniques. In addition, it improves efficiency, reduces production time, and provides greater flexibility in the design and fabrication process, making it increasingly popular in prosthodontics[1].

Despite the advantages of 3D printing, acrylic resins used in dental applications still exhibit several limitations. These materials may show reduced surface hardness, which can affect their resistance to wear during clinical use. Moreover, increased surface roughness may promote microbial adhesion and biofilm formation, which can negatively influence oral hygiene and the longevity of dental prostheses[2].

Three-dimensional printed resin exhibited inferior properties such as strength, hardness, increased candida adhesion and roughness of surface in comparison to the heat polymerized resin[3,4]. Surface roughness is an important factor in dental materials, as rough surfaces can facilitate the accumulation of microorganisms and increase the risk of oral infections[5].

Hardness testing is recognized as a simple and effective method of assessing the mechanical properties of polymer-based products. The increased mechanical

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properties, particularly hardness, can be used to improve wear resistance[6].

Recently, natural bioactive agents such as plant-derived essential oils have gained attention in dentistry due to their antimicrobial, antioxidant, and biocompatible properties. These natural substances are considered safer alternatives to synthetic additives and may help improve the biological performance of dental materials[7].

Oral microbial infections can be effectively treated with herbal medicines with little to no adverse effects. As a result, there is a global trend in the direction of studying them in an effort to discover herbal-based, biologically safe drugs with strong antifungal properties[8].

Among these herbal remedies are plant oils. Numerous studies have lately examined the effects of different oils on Candida albicans, and the results indicate that plant oils are a desirable treatment with strong antifungal properties for denture-induced stomatitis[9].

The use of naturally occurring products has recently gained popularity. Essential oils are concentrated hydrophobic liquids with a range of pharmacological properties that are extracted from plants. Because essential oils have antimicrobial qualities, several nations employ them in herbal medicine[10].

Rosemary (Rosmarinus officinalis L.), a prominent medicinal and aromatic herb of the Lamiaceae family, has long been cultivated. Rosemary is believed to have been utilized as a culinary, cosmetic, and medicinal element in ancient Egypt, Mesopotamia, China, and India[11]. This is a plant that is frequently employed in modern medicine. Among the many therapeutic benefits of rosemary are antibacterial and antioxidant qualities[12]. Despite the increasing use of 3D-printed acrylic resins in dentistry, information regarding the influence of natural additives on their surface properties remains limited. Therefore, this study was conducted to investigate the effect of adding rosemary oil at different concentrations (1%, 2%, and 3%) to 3D-printed acrylic resin. Specifically, the study evaluated changes in surface hardness and surface roughness following the incorporation of rosemary oil.

METHODOLOGY

This descriptive study was conducted at College of Dentistry, Mustansiriyah University, Iraq from 1st February 2026 to 31st March 2026 letter No.ERC/S-26-13 dated January 13, 2026. Thirty-two specimens were divided into four major groups: add of oil. (1) Control group: This group comprised of 8 specimens of 3D-printed acrylic with no add of oil. (2) Group (1%): This group comprised of 8 specimens of 3D-printed acrylic treated with 1 ml of rosemary oil. (3) Group (2%): This group comprised of 8 specimens of 3D-printed acrylic treated with 2 ml of rosemary oil. (4) Group (3%): This group comprised of 8 specimens of 3D-printed acrylic treated with 3 ml of rosemary oil. All specimens were prepared for testing, including (surface roughness test and hardness test).

Fabrication of 3D specimen blocks: The designing procedure was done using software Materialise magics (version 24.0; Materialise, Leuven, Belgium), in which the 3D design was created virtually. The design of specimens for surface roughness, hardness had specific dimensions according to specification for that test and materials. The design of surface roughness test and hardness was the same which was bar shaped specimen according to ADA specifications No.12, 1999 with dimensions of (65x10x2.5 mm) length, width, and thickness. The samples were designed by using (HALOT BOX) software before printing, to test the mechanical and physical property tests according to ADA specifications No.12, 1999 with a rectangular bar 2.5× 10× 65 mm3 (±0.2 mm) for roughness and hardness test. The sample plans were saved as STL file then imported into the 3D printing software (Creality/Halote R6).

The file is exported to 3D printer software (HALOT BOX) as shown in figures 1-3 and printed with 90-degree angle. After printing was finished, the samples were taken off the platform and the support structures were cut off. The samples were then cleaned with 99% ethanol in an ultrasonic cleaner to remove the excess monomer (Fig. 4). The samples were washed by two steps; first prewashing 2 minutes and second post washing 2 minutes according to recommendation in ultrasonic and then left in air 30 minutes to dry before post curing.

Each group made from 3D printing resin after printing process was placed in the UV curing chamber for 10 minutes according manufacturer instruction of the resin. After completing post-curing stage, polishing burs and dental disks were used to polish and finish the samples. Polishing was performed on a single surface of every specimen, specifically the surface designated for hardness measurement. The opposite surface was reserved for surface roughness testing and was not polished.

Surface roughness test was performed using surface roughness profilometer tester (TR200) with 0.001 micrometer accuracy at the University of Technology, Materials Engineering Department (Fig. 5). This tester contained a diamond sensitive needle (stylus) used to track the irregularities on the surface. Three separated locations on the specimen's surface were just touched by the stylus to have three readings for each sample, so according to profilometer instructions; the sample was located on a stable, rigid surface and the stylus should be allowed to contact the first point, then it was moved for 11 mm across the sample, the readings appeared on the digital scale in a spontaneous manner. Later, a roughness values were determined by calculating the mean values of these reading in micrometers (μm).

The Shore hardness durometer is widely used to determine the indentation hardness of polymers such as plastics and rubber. The measurement is based on the depth of penetration of a standardized indenter under a defined spring force, which is converted into a hardness value ranging from 0 to 100. For harder materials, the Shore D scale is applied, where a sharper indenter and higher force are used compared to Shore A. The hardness value is inversely related to the penetration depth; thus, harder materials exhibit lower indentation. Standardized testing procedures, including indenter geometry, applied force, and duration of force application, are defined to ensure accuracy and repeatability of results.

A statistical package was used to analyze the data by SPSS-20. Two means were compared using the LSD test and the one-way ANOVA test. A significance level $p<0.05$ was considered significant.

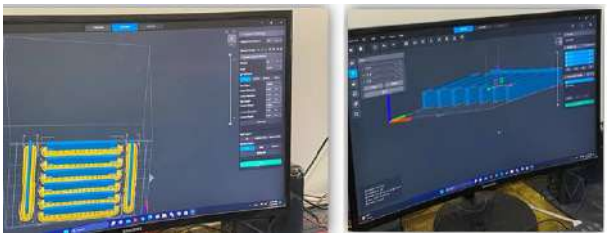


Figure No. 1: 3D printer software



Figure No. 2: (Creality/Halote R6) 3D printing



Figure No. 3: Final printed specimens at the printer plate



Figure No. 4: Ultrasonic cleaner



Figure No. 5: Surface roughness profilometer tester (TR200) with 0.001µm accuracy

RESULTS

The surface roughness test's descriptive statistics is shown in Table 1. The highest mean value of the test was 1.911 following the addition of 1% rosemary oil, while the lowest mean value was (0.883) following the addition of 2% rosemary oil. When one-way ANOVA test was applied, a highly significant ($p> 0.05$) difference in groups value (Table 2). The addition of rosemary oil, the surface hardness test included, the findings showed that the greatest mean value of the surface hardness test was (79.525) after addition of 1% rosemary oil while the lowest mean value of the surface hardness test was (76.475) after addition of 2% rosemary oil (Table 3). One-way ANOVA test was used and indicated a highly significant ($p>0.05$) difference between the group values (Table 4).

Table No. 1: Descriptive statistics for surface roughness

Groups	Mean	Std. Deviation	Std error	Minimum	Maximum
100 % (control)	0.936213	0.0043182	0.0015267	0.9290	0.9430
99%	1.910625	0.0437039	0.0154517	1.8387	1.9393
98%	0.882838	0.0083125	0.0029389	0.8710	0.8930
97%	1.590125	0.2178433	0.0770193	1.3067	1.9110
Overall	1.329950	0.4552447	0.0804767	0.8710	1.9393

Table No. 2: One-way ANOVA and multiple comparisons between groups by LSD to compare surface roughness

ANOVA					
	Sum of Squares	**Df**	**Mean Square**	**F**	**P-value**
Between Groups	6.079	3	2.026	163.885	0.000
Within Groups	0.346	28	0.012		
Total	6.425	31			
LSD					
(I) Groups	**(J) Groups**		**Mean Difference (I-J)**		**P value**
100 % (control)	99%		-0.9744125		0.000
	98%		0.0533750		0.345
	97%		-0.6539125		0.000
99%	98%		1.0277875		0.000
	97%		0.3205000		0.000
98%	97%		-0.7072875		0.000

Table No. 3: Descriptive statistics for surface hardness

Groups	**Mean**	**Std. Deviation**	**Std error**	**Minimum**	**Maximum**
100 % (control)	78.150	0.5210	0.1842	77.0	78.8
99%	79.525	0.3196	0.1130	79.0	80.0
98%	76.475	0.7479	0.2644	75.4	77.6
97%	77.350	0.8734	0.3088	76.4	78.8
Overall	77.875	1.2969	0.2293	75.4	80.0

Table No. 4: One-way ANOVA and multiple comparisons between groups by LSD to compare surface hardness

ANOVA					
	Sum of Squares	**Df**	**Mean Square**	**F**	**P-value**
Between Groups	40.270	3	13.423	31.664	0.000
Within Groups	11.870	28	0.424		
Total	52.140	31			
LSD					
(I) Groups	**(J) Groups**		**Mean Difference (I-J)**		**P value**
100 % (control)	99%		-1.3750		0.000
	98%		1.6750		0.000
	97%		0.8000		0.020
99%	98%		3.0500		0.000
	97%		2.1750		0.000
98%	97%		-0.8750		0.012

DISCUSSION

The application of three-dimensional printing technology for acrylic materials has increased markedly in recent years. Advances in printing accuracy and material performance have enhanced its reliability, encouraging its use in an expanding range of dental procedures[13]. The primary goal of 3D printing technology is to manufacture functional materials in a rapid manner. During the printing process, the material is formed in successive layers, with the build platform moving to allow each new layer to be cured before the next one is added[14,15]. Several factors must be carefully controlled during the 3D printing process, as they can influence the properties of the printed material. These factors include the depth of polymerization, layer thickness, printing volume, printing direction, and light-induced shrinkage from the curing source[16]. Some disadvantages like poor mechanical properties of resin required strengthening acrylic resin materials properties[17] by adding various reinforcing materials such as fibers, nanoparticles[18,19].

Rosemary oil is a natural essential oil extracted from the plant Rosmarinus officinalis. It contains several active compounds, including cineole, camphor, and α-pinene, which contribute to its biological properties. In dentistry, rosemary oil has demonstrated effectiveness against oral microorganisms, particularly Candida albicans, which is commonly associated with denture stomatitis. Studies have shown that rosemary oil exhibits strong antifungal activity and can reduce microbial growth[20]. The addition of rosemary oil can improve certain mechanical properties, such as hardness, without significantly affecting surface

roughness. Moreover, its antimicrobial activity may reduce microbial adhesion on denture surfaces, thereby improving their clinical performance[21].

Steve et al[22] examined the mechanical characteristics of 3D printed denture base resin containing microcapsules loaded with plant essential oils and found that while the incorporation of plant oils had little effect on flexural modulus and Vickers hardness, it had a negative impact on flexural strength and surface roughness. Sulaiman et al[23] also examined the effects of adding grapefruit seed skin particles to 3D-printed acrylic at various concentrations on the degree of conversion, surface hardness, flexural strength, and tensile strength. They came to the conclusion that the addition of grapefruit seed skin particles to 3D-printed acrylic is advised due to its notable improvements in the mechanical properties of 3D printed denture base resin. Aziz et al[24] tested cleansers on 3D printer resin and concluded that when they used as a denture cleaner, thyme essential oil preserves surface roughness better than Polident denture cleanser, although it has less of an impact on the hardness and transverse strength of the 3D Printed denture foundation. Finally, an experimental study by Rashid[25] assessed the effects of various ratios of Vitis vinifera oil with concentrations of 1%, 2%, and 3% on the 3D-printed resin material's surface roughness, hardness, and color change. The study found that the hardness, roughness, and color change value of 3D printer acrylic resin were unaffected by the addition of 1% Vitis vinifera oil (an antifungal oil) when compared to the control group. Roughness is necessary test in prevention microorganism to attached to denture base, the results of this study revealed that the roughness decreased in addition of rosemary oil with 2% concentration while the surface hardness increased in addition of rosemary oil with 1% concentration in that significantly improved the mechanical properties of 3D printed acrylic resin. This can be explained by better dispersion of rosemary oil with 3D printed acrylic resin matrix that blended with enough homogeneity between the two materials at the previously mentioned specific concentrations and enhanced properties by lowering roughness value and increasing hardness readings.

Due to its composition and the fact that 3D-printed resin has less double bond conversion than traditional polymethylmethacrylate denture material, pure resin without any additions, referred to as the control group, has a lower surface hardness than the rosemary 1% concentration group[26]. The degree of conversion and stability are increased when oil is added to 3D-printed resin. The strength of the resin-oil bond may also account for this increase. The experimental groups' surface hardness was also considerably raised by the enhanced degree of conversion[23].

CONCLUSION

Addition of rosemary oil with concentration of 2% decreased surface roughness of 3D printed acrylic resin (recorded the lowest mean value) and addition of rosemary oil with concentration of 1% increased surface hardness of 3D printed acrylic resin (recorded the highest mean value). Addition of rosemary oil in specific concentrations improved surface hardness and reduced surface roughness of 3D printed acrylic resin.

Author's Contribution:

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Drafting or Revising Critically:	Shaymaa Majid Abdulhameed, Issam Ahmed Mohammed, Samir Samier
Final Approval of version:	All the above authors
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Original Article

Early-Life Digital Exposure Patterns and their Association with Language Delay Severity and Developmental Outcomes in Children with Normal Hearing: A Cohort-Based Analytical Study

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ABSTRACT

Objective: To evaluate the relationship between digital device exposure patterns and language delay severity, while examining their association with developmental outcomes in a carefully filtered pediatric cohort

Study Design: Retrospective cohort-based analytical study

Place and Duration of Study: This study was conducted at the College of Medicine, Al-Qadisiyah University, Iraq, from 1st December 2025 to 31st March 2026.

Methodology: 500 pediatric records were initially assessed. After applying strict inclusion criteria, 95 cases were retained for final analysis.

Results: A highly significant increase in daily screen time was observed with increasing language delay severity ($P \leq 0.001$), with strong pair-wise differences between mild vs. moderate and mild vs. severe groups ($P \leq 0.001$). Screen time showed a strong positive correlation with severity scores ($r \approx 0.70$, $P \leq 0.001$). Conversely, sleep duration significantly decreased with increasing severity ($P \leq 0.001$), demonstrating a negative correlation ($r \approx -0.45$, $P \leq 0.001$). Early initiation of device use was significantly associated with poorer developmental outcomes ($P \leq 0.001$). The significant association between high screen exposure (>4 hours/day) and increased severity of language delay ($P \leq 0.001$). Additionally, developmental assessment outcomes were significantly influenced by device exposure patterns and age of initiation ($P \leq 0.01$). No significant differences were observed with respect to gender distribution.

Conclusion: Excessive screen exposure and early initiation of device use were strongly associated with increased language delay severity and poorer developmental outcomes in children. Reduced sleep duration further amplified these effects.

Key Words: Behavioral modulation, Developmental phenotype, Pediatric cognition, Screen exposure.

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INTRODUCTION

It is widely accepted that early childhood is the critical period for acquiring language and stimulating cognitive development. During this window of development, the environment plays the most significant role in determining the level of neural development and the extent of communication skills development. Children are being exposed to digital media more at younger ages than has ever been the case. This trend is worrying because of the many unknowns that might accompany the rapid digital media exposure in early childhood development. Previous studies indicated that increased screen time negatively impacts rapid media exposure and can be improved by increased interactive verbal communication between a parent and a child.[1]

The increased screen time is negatively correlated with language development. The use of media at infants predicted the ability to express oneself. Furthermore, even when media was viewed without a parent present, early exposure to media was correlated with a delay in

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language development.[2] More recently, when screen exposure was measured at 1 years of age, there was decreased communication ability in children at 2 and 4 years of age.[3]

The extent, to which the digital pattern of exposure was influential, apart from duration, was remarkable. Age of first exposure, device type, and parental supervision level impacted developmental outcomes. In the absence of supervision, children faced a significantly greater risk of developmental delays from unstructured device use than those with limited media-guided use.[4] There was global evidence indicating that children exceeding the recommended screen time guidelines were at an even greater risk, as most children fell within this cohort.[5]

Most researches to date has been focused on developmental delay without examining aftermath of the situation that most research is focused on without splitting out the aftermath. In addition, few studies included frustration hearing as a control, but few studies looked at hearing, which is a key element of language. The lack of these recommendations generally leads to an unbalanced view of the association. Inequitable opportunities in early life, parental involvement, and early childhood condition inequitable, and these gap.[6]

Within these gaps, the current study was formulated to assess the relationship between the severity of language delay and the digital exposure patterns among children with verified normal hearing. An additional purpose was to investigate the relationship between the exposure parameters and the developmental assessment results. This methodology facilitates a greater degree of clarity as to whether screen exposure is a principal cause of severity or a modifying factor within a more expansive developmental framework.

METHODOLOGY

This retrospective cohort-based analytical study was conducted at College of Medicine, Al-Qadisiyah University, Iraq from 1st December 2025 to 31st March 2026 vide letter No. 276 dated November 5, 2025. The study population 500 cases were further refined by applying more inclusion and exclusion criteria. Only children with results from hearing tests that showed normal hearing were included in the final analyses. All cases were excluded that showed even a mildly moderate degree of hearing loss. In addition, children presenting any form of behavioral problem (hyperactivity, tantrums, poor eye contact, etc.) were also excluded to reach 95 cases. This was done in order to avoid possible confounding effects on language and developmental outcomes. Based on these criteria, a subset of eligible participants was selected for final statistical analyses.

Participants were divided into three groups: mild, moderate, and severe language delays. The assessment criteria to classify participants into clinical and developmental assessments were standardized and recorded in the files of the participants. To ease statistical modeling and correlation analysis, severity was encoded to a certain number for the sake of the analysis. Systematic extraction of records, using a structured format, included demographic data such as age (in months), sex, daily screen time (hours/day), age at which the child began using the assigned device (months), device type (mobile, tablet, both), and whether the device was used with parental supervision (yes/no). Furthermore, behavioral traits, such as tantrums, hyperactivity, and reduced eye contact, were noted.

Exposure to screening was classified into three categories: ≤2 hours/day, 2-4 hours/day, and >4 hours/day. First use age of device was categorized into ≤12 months, 13-24 months, and >24 months aiming to capture and reflect developmental milestones. Device type and parental supervision were treated as categorical variables. Standardized developmental assessment records were used to assess developmental status. Outcomes were classified into three groups: normal development, borderline delay, and confirmed developmental delay. Statistical analysis was performed using SPSS-25. One-way analysis of variance (ANOVA) was used to compare mean scores between three or more groups. The Welch t-test was used for pairwise comparisons. The Chi-square test was used to test the association of categorical variables. A p-value of less than 0.05 was considered statistically significant. One quantitative variable was assessed by Spearman rank correlation to determine correlation between them.

RESULTS

The age distribution covered a broad pediatric span, reflecting the wide range of developmental stages. The cases were grouped into language delay levels of mild, moderate, and severe to create a clear basis for the planned analyses. There were statistically no significant ($P>0.05$) differences in sex distribution by severity categories (Table 1).

The shift of the distribution pattern indicated higher exposure durations, especially amongst the older children. This demonstrates more time spent engaging with the digital devices. The starting age of children being exposed to digital devices indicated a tendency for children to start using the devices earlier, with most of the children starting the usage of digital devices during the age of critical neurodevelopment. Exclusive use of tablets was less common, as well as use of mobile phones. Part of the children used the devices without any supervision at all, and the use of devices without supervision was more common than use of devices with supervision. These findings provide the widespread context for the relationship between developmental outcomes and the digital exposure

(Table 2). Panel A breaks down the range of daily screen exposure and shows that most subjects have long screen exposure. Panel B breaks down the age that subjects first began using screens. Most subjects showed early screen exposure as children. Panel C breaks down the type of screens/technology used and shows that most subjects used a mobile device. Panel D shows the extent of parental supervision of screen use, and most subjects experienced unsupervised screen exposure. Language delay severity ($P \leq 0.001$) was significantly and comparably correlated to higher screen exposure. Device type and parental supervision were significantly and comparably correlated, but the correlation was weak ($P > 0.05$).

It was found a clear relationship between time spent with screens and severity of language delay. Participants were categorized 'severe language delay' had more mean screen times than the moderate language delay participants, and the moderate language delay participants had more mean screen time than the mild language delay participants. One-way ANOVA shows us how different three groups ($P < 0.001$). If the difference between the three groups is clear, it makes sense to measure the difference between the two language delay groups in a pair, and of course, using Welch's t-test to measure the difference between the language delay groups mild-moderate, mild-severe, and moderate-severe. Age of screen time use also gives us a sense of how language delay severity is correlated: earlier screens meant language delay severer. This is a good example of early screen time of greater average developmental delay ($P \leq 0.01$) and less sleep in ($P \leq 0.001$) severest language delay. It is a fair interpretation about screen time, sleep, and language delay severity, and they sleep less and have more screen time than children in the mild and moderate groups (Fig. 1). In panel A, daily screen time shows a significant increase in exposure with greater severity in the mild, moderate, and severe groups ($P \leq 0.001$). Significant pairwise differences were confirmed between mild vs. moderate ($P \leq 0.001$), mild vs. severe ($P \leq 0.001$), and moderate vs. severe ($P \leq 0.05$). In panel B, early onset of device use was significantly correlated with higher severity levels ($P \leq 0.01$). In panel C, as severity increased, sleep duration decreased significantly ($P \leq 0.001$), with the most significant pairwise differences observed between mild and severe groups ($P \leq 0.001$).

The mild language delays were more often associated with either normal or borderline outcomes of developmental achievement. This gradient pattern demonstrates a relationship in the imbalance of linguistic function and the imbalance of developmental function, reinforcing the idea that cognitive and linguistic development is interdependent. The lack of supervision by parents, the high screen time, and the early initiation of screen time were always aligned subsumed the adverse developmental outcomes. The more dominant the supervised low screen time, the more favorable the developmental outcome. The relationships among multiple variables emphasize the interdependence of the development and the environment in the overall progress of development. This is especially true in the case of impaired pediatric development overall (Fig. 2). The provided heatmap reveals the correlation between levels of language delays and delays in the developmental assessment, duration of device usage, and patterns of supervision. The most evident is language delays and negative outcomes in developmental assessments. High screen time and early initiation of the device were constantly linked to negative developmental outcomes, whereas low screen time and good parental supervision were linked to normal or borderline developmental outcomes. The correlation between the delays in language development and the delays in the assessment of developmental milestones is substantial and has statistical significance ($P \leq 0.001$). The correlation of the type of device and supervision, is mixed, some correlations are significant ($P \leq 0.05$) and some are not significant ($P > 0.05$).

The daily time spent with screens showed a high positive correlation to the language delay severity of ($r \approx 0.70$, $P \leq 0.001$), thus the more severe the language delay, the more time spent on screens, and the more screen time. The relationship that is consistent and strong screen time and language delay. Additionally, the sleep duration showed a moderate negative correlation to the language delay severity ($r \approx -0.45$, $P \leq 0.001$), that is the lesser the sleep, the more severe the language delay. The correlation found for the age of children using digital devices for the first time and developmental outcomes being significant and negative means the earlier the age of first use, the poorer the developmental outcomes ($P \leq 0.01$). A negative correlation between developmental health and the amount of time a child spends using digital devices. Lack of sleep, on the other hand, appears to have a positive influence on developmental health. The correlation matrix shows how integrated and inter-related the variables are to each other, as well as how good analytical framework of the study (Fig. 3). Daily screen time and severity of language delays had a strong positive correlation ($r \approx 0.70$, $P \leq 0.001$). The greater the severity of the language delays the less sleep, with a moderate negative correlation of sleep duration with severity ($r \approx -0.45$, $P \leq 0.001$). The age at which screen time was first introduced had a negative correlation with development, such that earlier screen time was associated with poorer developmental outcomes ($P \leq 0.01$). Other correlations between the variables were weaker and not significant ($P > 0.05$). The matrix is an aggregate look at the correlations of the variables.

Table No. 1; Comparison of genders

Gender	Mean±SD	P value
Male	43.25±7.39	0.3049 (NS)
Female	58.26±5.28	

Table No. 2: Comparison of age groups

Age (months)	Mean±SD	P value
<24	18.25±11.16	0.0451 (S)
24-35	27.28±21.30	
36-47	33.31±28.35	0.5225 (NS)
49-49	22.23±18.22	

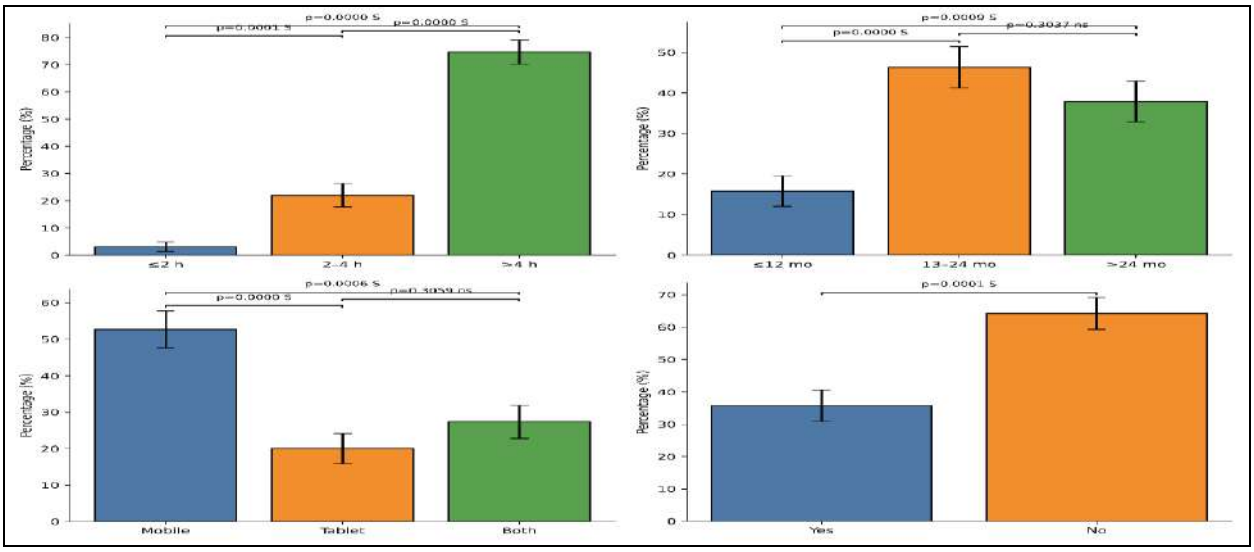


Figure No. 1: Multi-panel descriptive exposure profile

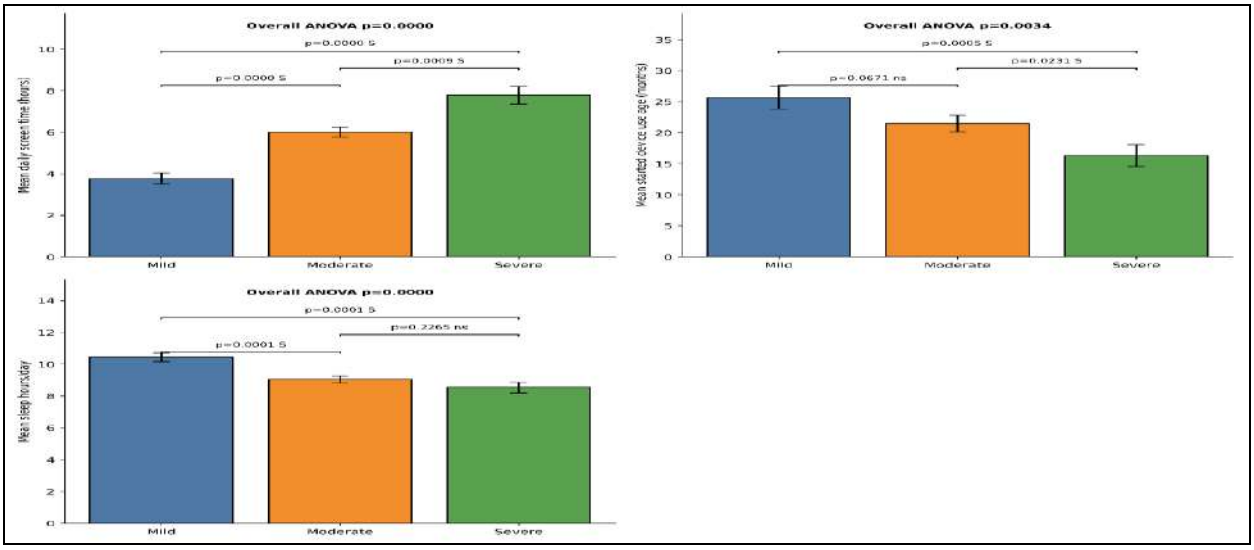


Figure No. 2: Severity of language delay versus exposure variables

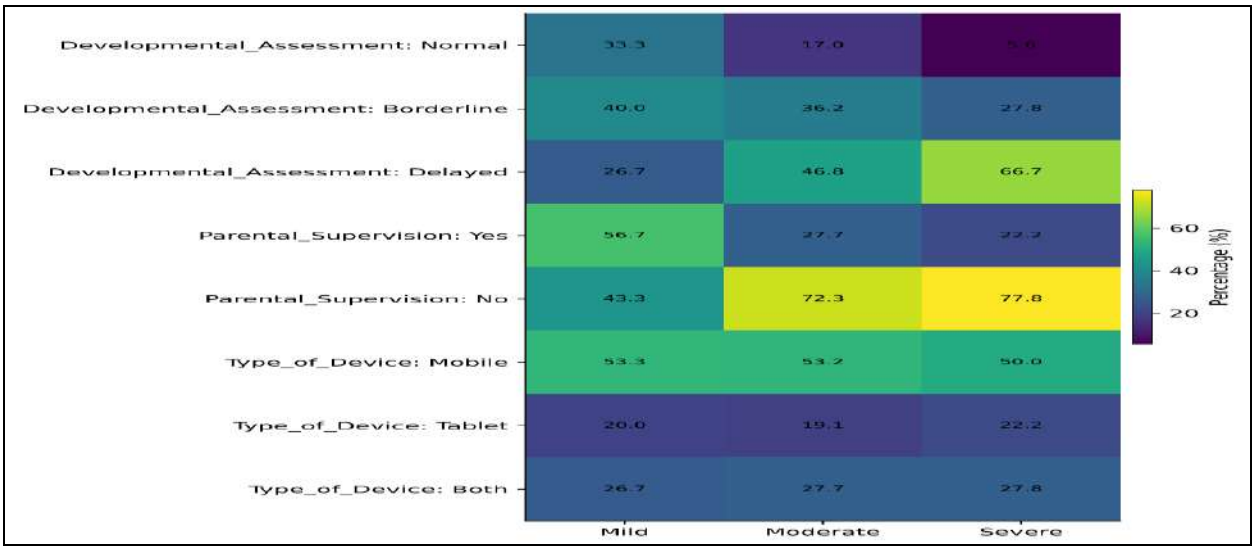


Figure No. 3: Developmental phenotype heat map

DISCUSSION

This study showed a considerable number of children were observed to have prolonged daily screen use, with a significant number exceeding four hours. A number of recent report has documented the continued out of the target screen time recommendations of children globally.[5]

Most of the reports digital screen exposure to children has focused on the use of a mobile device. This in itself, demonstrates the continued evolution of digital media where, in most cases, collapsible and portable media have replaced traditional forms of viewing media (e.g. television viewing). The difference in levels of parental involvement during screen use suggests not only the extensive screen use but also the unmonitored use of screen time. The absence of adult moderation during media use has been recognized by researchers as one of the most important aspects of media use that can influence positive or negative developmental outcomes.[7,8] The findings of this study suggest that the screen exposure profiles of children in this study were not only determined by the total screen exposure time but also by the contexts, quality of exposure and the nature of the screen time activities at the time of exposure, all of which contributed in varying degrees to increased developmental risk.

This study showed that there is a strong and statistically relevant correlation between daily screen time and language delay severity. Compared to children with mild and moderate language delays, children with severe language delays spend significantly more time, and the differences are significant across all groups. This finding supports the research, and states that screen time may inhibit language development because children are not interacting and receiving the proper verbal stimulation because they are too busy staring at a screen.[9]

The more severe the delays, less children sleep. Developmentally, this sleep deprivation may create further delays. The Prior study has focused on sleep as an indirect mediator, whereas the present study shows that sleep reduction is directly and more strongly correlated to an increase in the severity levels.[10] The early onset screen time use was also significantly correlated to severity. This supports the theory that when young children are in the developmentally sensitive period with neural plasticity, the screen time will have a greater negative impact on the child's development.[11] This study shows that total divisor (screen time and sleep) and the time frame (early screen time use) is crucial in regard to the language development.

The most evident association was made between the outcomes of the developmental assessment and patterns of parental supervision. Children who used digital media while supervised by parents, showing some level of parental control, experienced more positive developmental outcomes than children who used digital media without supervision. This is consistent with the evidence that parents watching media with children and actively talking to children while watching media can reduce some of the negative effects of the media and even improve their thinking and language skills.[12]

Many studies have pointed out that the amount of time children spend using screens and their exposure to other environmental and social factors are not unrelated.[13,14] This study showing, particularly, the nature of supervision and how the media is used are important factors in the development of the children.

Correlation analysis shows a systematic structure for the main quantitative variables, given the daily screen time and language delays, whereby the greater the exposure the greater the language delay and vice versa. Additionally, sleep duration is negatively correlated with delay severity, meaning the less sleep the greater the delay. While a strong individual correlation is apparent, the language delay results seem to arise, fundamentally, from a multitude of interacting variables rather than one dominant variable. Integrated flow analysis shows that children with the same levels of exposure did not always follow the same developmental pathways, which suggests the presence of controlling variables like the level of supervision and the timing of the exposure. This multidimensional structure is consistent with the developmental models of Kucker and Schneider[15], which posit that cognitive outcomes develop from the interaction of environmental, biological and behavioral exposures.

CONCLUSION

The level of language delay and the age in which children begin using devices is correlated with the amount of time children spend using devices and the amount of time children spend using devices and the amount of time children spend using devices. The level of language delay is also affected by the amount of sleep children get. Children be given less time using devices and improve children s sleep time, and better use of devices, and the amount of time children spend using devices and the amount of time children spend using devices.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Shaima'A Dakhel Abdulhassan, Safa'A Dakhel Abdulhassan
Drafting or Revising Critically:	Shaima'A Dakhel Abdulhassan, Safa'A Dakhel Abdulhassan
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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Original Article

Pain Management at Oncology Units

Nurses Perception and Barriers toward Pain Management at Oncology Units

Sahar Sattar Al-Ghazi[1] and Fakhria Jaber Muhaibes[2]

ABSTRACT

Objective: To determine the perceived barriers to effective pain management in oncology units and to find out the relationship between nurses' sociodemographic and professional characteristic and their perceptions and barriers toward pain management

Study Design: Descriptive cross-sectional study

Place and Duration of Study: This study was conducted at the Middle Euphrates Health Institutions in the Governorates of Babylon, Karbala and Najaf, from 1st September 2025 to 28th February 2026.

Methodology: 200 participants were enrolled.

Results: Sociocultural beliefs were the most notable perceived barriers. The belief that a patient's level of pain is a reflection of their underlying health condition and the course of their disease was the most highly rated barrier (63%), followed by the belief that suffering is a test from Allah (55.5%).

Conclusion: A moderate level of perceive barriers, the relationship between nurses' sociodemographic and professional characteristics and perceived barriers toward pain management.

Key Words: Perception, Barriers, Pain management, Oncology.

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INTRODUCTION

Pain is among the most prevalent and distressing symptoms in cancer patients, occurring in 37% to 64% of patients depending on the stage and treatment. Prevalence reaches 50% across all phases and rises to 66% in advanced stages. Approximately 30% of patients experience moderate to severe pain, increasing to 40–50% in more severe cases.[1] Among cancer patients, pain remains a persistent and undertreated problem. Over 40% of patients receive inadequate pain management. The International Classification of Diseases (ICD-11) now includes the taxonomy 'chronic cancer pain' to reflect its distinct clinical burden.).[2] The cancer patients also experience fatigue due to therapy or other unknown factors. Cancer patients describe this chem. with phrases like "I feel tired," "weak," "exhaustion," and "weakness," which can appear suddenly at any time and persist for months after op into a major treatment is completed.[3]

Despite advances in cancer treatment, effective pain management remains a critical challenge. More than one-third of cancer patients experience inadequately treated pain. Cancer pain is a complex condition arising from inflammatory, neuropathic, and tumor-related mechanisms.[4] The nurses encounter multiple barriers such as limited knowledge in pain assessment, negative attitudes toward strong analgesics, absence of clear protocols, and organizational challenges like resource constraints and workload pressure.[5] Pain management is crucial for cancer patients, but it can be challenging due to a number of factors, including factors related to healthcare providers, patients, and the healthcare system.[6]

Nurse-related barriers include inadequate education on pain mechanisms and types of analgesia, insufficient assessment and documentation of pain, negative attitudes towards opioid medications, lack of experience and knowledge, and other challenges faced by nurses in managing cancer pain.[1] Patient-related barriers include a lack of knowledge about pain management techniques, inadequate use of opioids, negative pain complaints, and patients' attitudes and beliefs about pain and analgesics.[7] Organizational-

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related barriers include strict opioid regulation, remote areas, staff shortages, and a lack of clear and consistent pain management guidelines.[8]

METHODOLOGY

This descriptive cross-sectional study was conducted in Middle Euphrates Health Institutions, Governorates of Babylon, Karbala, and Najaf from 1st September 2025 to 28th February 2026 letter No. 535 dated 15-8-2025. Twenty of the 220 nurses who were selected for the study participated in the pilot study, while the remaining 200 nurses comprised the main study sample. The nurses who worked in oncology units and who wanted to participate were included. The nurses who did not work in oncology units and who did not want to participate were excluded. Data was gathered using a structured self-administered questionnaire consisting of 54 items divided into four sections: Demographic and Professional data, pain assessment and documentation, nurses' perception, and barriers toward pain management. It took about (15-20) minutes to complete the questionnaire. The instrument's tools were validated by a panel of 11 nursing experts. The reliability test showed good internal consistency with a Cronbach's alpha level (0.79). The data was analyzed through SPSS-26. Shapiro-Willk test, Kruskal-Wallis H test, and Mann-Whitney U test utilized to assess normality of data distribution.

RESULTS

Mostly the participants were from Karbala 46.5% and young 61% falling in the 20-29 age and a slight majority 55% were males. They possessed a bachelor degree in nursing 67%, and were in the urban areas 81.5%. The staffing was relatively young with 41% having a total nursing experience of 1-3 years with more than half (55%) having only 1-3 years of experience in oncology units in particular. A large portion of the participants 77% indicated that they had obtained specific training in pain management (Table 1).

The patient beliefs (high assessment) are the greatest impediments that have been identified (Mean=2.37, and Mean=2.50 respectively), which are the cultural/religious concept that suffering is a God-sent test (Cultural/religious beliefs) and the perception that there is a direct relationship between the severity of pain and the progression of the disease (Mean=2.50). Systemic problems also made it in the list of moderate barriers with hospital regulations on access to outside painkillers (Mean=2.15) and policies which restrict prescription power to certain physicians (Mean=2.12) taking the lead. Interestingly, structural barriers such as staff shortages (Mean=2.00) and the absence of assessment tools (Mean=1.96) were viewed as moderate barriers but the psychological support services (Mean=1.60) and the belief that nice patients do not complain (Mean=1.61) were considered the lowest barriers (Fig. 1).

The overall assessments of barriers toward pain management in oncology wards shows a moderate level of perceived barrier, with the mean score of 1.91=0.31. The results revealed that the majority of the nurses (77%) barriers are moderate with 16.5% low and only 6.5% are high (Table 2).

The Governorates (p=0.000) remains a significant source with Karbala nurses having the highest perception scores. Academic qualification (p=0.004) and being given special training in pain management (p=0.002) both significantly contribute to positive perceptions. Besides that, marital status (p=0.044) was statistically significant in this model and single nurses reported significantly higher scores in this perception than their married or divorced colleagues.

Table No. 1: Association between sociodemographic and professional data and overall assessment of barriers (N = 200)

Variable	Mean±SD	P value
Governorates		
Karbala	93	46.5
Al-Najaf	76	38.0
Babylon	31	15.5
Age (years)		
20–29	122	61.0
30–39	65	32.5
40–49	13	6.5
Gender		
Male	110	55.0
Female	90	45.0
Marital status		
Single	102	51.0
Married	90	45.0
Divorced	8	4.0
Residence		
Urban	163	81.5
Rural	37	18.5
Academic qualification		
Bachelor's Degree	134	67.0
Diploma	63	31.5
Master's Degree	3	1.5
Nursing experience (years)		
1–3	82	41.0
4–6	60	30.0
7–9	41	20.5
> 10	17	8.5
	110	55.0
Oncology unit experience (years)		
1–3	110	55.0
4–6	63	31.5
7–9	21	10.5
> 10	6	3.0
Pain Training		
Yes	154	77.0
No	46	23.0

Table No. 2: Barriers to pain management identified by 200 nurses

Item	Agree n (%)	Neutral n (%)	Disagree n (%)	Mean	SD	Assessment
Believing suffering is a test from God (Allah)	111 (55.5)	52 (26.0)	37 (18.5)	2.37	0.78	High
Pain degree and health state are related	126 (63.0)	47 (23.5)	27 (13.5)	2.50	0.72	High
Believing suffering is unavoidable in cancer	91 (45.5)	53 (26.5)	56 (28.0)	2.17	0.84	Moderate
Restricted external painkiller access	90 (45.0)	50 (25.0)	60 (30.0)	2.15	0.86	Moderate
Restriction to specific pain physicians	81 (40.5)	63 (31.5)	56 (28.0)	2.12	0.82	Moderate
Inadequate medical compliance	60 (30.0)	82 (41.0)	58 (29.0)	2.01	0.77	Moderate
Sickness is doctor's priority (not pain)	55 (27.5)	90 (45.0)	55 (27.5)	2.00	0.74	Moderate
Shortage of nursing staff	68 (34.0)	64 (32.0)	68 (34.0)	2.00	0.83	Moderate
Lack of proper assessment tools	68 (34.0)	57 (28.5)	75 (37.5)	1.96	0.85	Moderate
Difficulty in completing pain scales	53 (26.5)	86 (43.0)	61 (30.5)	1.96	0.76	Moderate
Lack of clear hospital policies/guidelines	63 (31.5)	61 (30.5)	76 (38.0)	1.94	0.83	Moderate
Insufficient training programs	62 (31.0)	64 (32.0)	74 (37.0)	1.94	0.82	Moderate
Inconsistent nursing practice (PRN meds)	58 (29.0)	68 (34.0)	74 (37.0)	1.92	0.81	Moderate
High nursing workload (time constraints)	54 (27.0)	68 (34.0)	78 (39.0)	1.88	0.81	Moderate
Lack of nursing knowledge	48 (24.0)	72 (36.0)	80 (40.0)	1.84	0.79	Moderate
Patient hesitation to report pain	45 (22.5)	71 (35.5)	84 (42.0)	1.80	0.78	Moderate
Lack of time due to frequent complaints	45 (22.5)	66 (33.0)	89 (44.5)	1.78	0.79	Moderate
Physician lack of faith in nurse assessment	46 (23.0)	61 (30.5)	93 (46.5)	1.76	0.80	Moderate
Patient avoiding annoying the nurse	42 (21.0)	61 (30.5)	97 (48.5)	1.72	0.79	Moderate
Patient fearing being a "complainer"	41 (20.5)	61 (30.5)	98 (49.0)	1.72	0.79	Moderate
Occasional unavailability of painkillers	42 (21.0)	58 (29.0)	100 (50.0)	1.71	0.79	Moderate
Fear of upsetting the doctor	30 (15.0)	80 (40.0)	90 (45.0)	1.70	0.72	Moderate
Preference for reporting to physicians	35 (17.5)	66 (33.0)	99 (49.5)	1.68	0.76	Moderate
Belief that "non-complainers" are "nice"	38 (19.0)	46 (23.0)	116 (58.0)	1.61	0.79	Low
Lack of psychological support services	39 (19.5)	42 (21.0)	119 (59.5)	1.60	0.80	Low

Table No. 3: Overall assessment of barriers (N = 200)

Level	Cutoff Points	No.	%	Mean±SD	Overall Assessment
Low	1.00–1.66	33	16.5		
Moderate	1.67–2.33	154	77.0	1.91±0.31	Moderate
High	2.34–3.00	13	6.5		

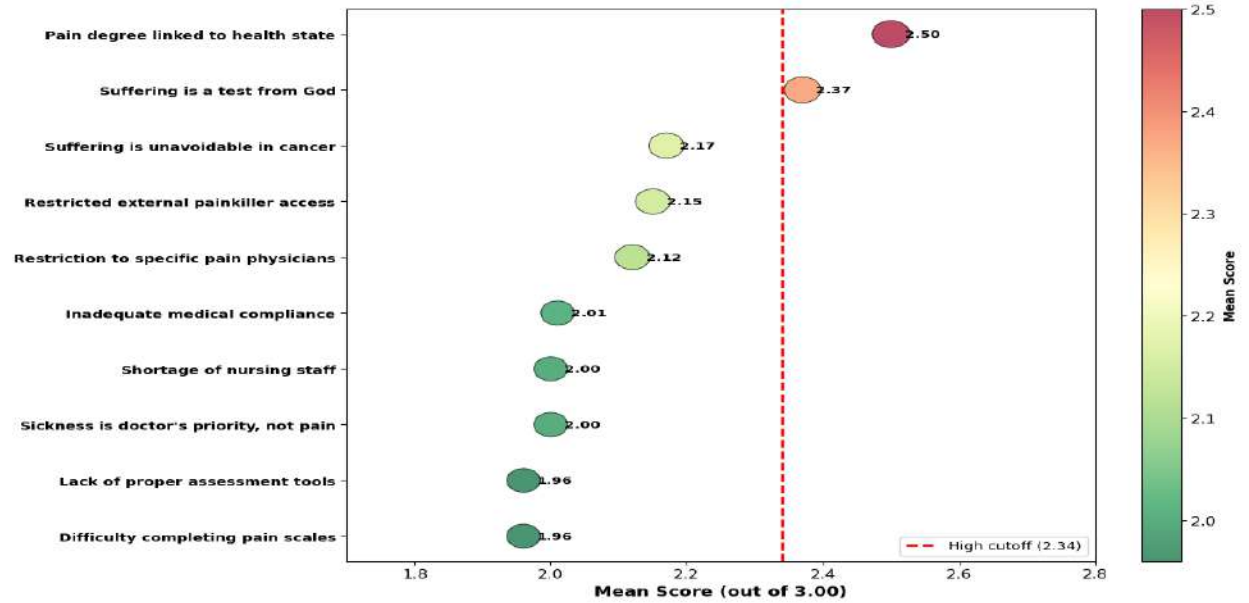


Figure No. 1: Barriers to effective pain management

Table No. 4: Association between sociodemographic and professional data and overall assessment of barriers (N = 200)

Variable	Mean±SD	P value
Governorates		
Al-Najaf	2.00±0.27	0.000 (H)
Babylon	1.97±0.23	
Karbala	1.83±0.35	
Age (years)		
20–29	1.90±0.33	0.018 (H)
30–39	1.90±0.28	
40–49	2.13±0.24	
Gender		
Male	1.90±0.32	0.297 (U)
Female	1.93±0.31	
Marital status		
Single	1.87±0.34	0.053 (H)
Married	1.94±0.29	
Divorced	2.04±0.19	
Residence		
Urban	1.93±0.32	0.143 (U)
Rural	1.84±0.25	
Academic qualification		
Bachelor's Degree	1.92±0.33	0.762 (H)
Diploma	1.90±0.29	
Master's Degree	1.96±0.24	
Nursing experience (years)		
1–3	1.89±0.33	0.107 (H)
4–6	1.90±0.23	
7–9	2.01±0.30	
> 10	1.85±0.45	
Oncology unit experience (years)		
1–3	1.87±0.31	0.015 (H)
4–6	1.93±0.28	
7–9	2.12±0.31	
> 10	1.83±0.41	
Pain Training		
Yes	1.89±0.32	0.006 (U)
No	2.00±0.27	

H=Kruskal–Wallis test; U=Mann–Whitney U test

DISCUSSION

The overall level of formal in pain management training amongst the participants in this study was relatively high (77%), however, the majority of nurses were very young, with nearly two thirds (61%) falling within the 20-29 age group, and the vast majority were working early careers in oncology. The present findings are broadly aligned with those reported in oncology nursing populations across neighboring Arab healthcare systems.[9]

The overwhelming majority of nurses in the current sample (67%) have a bachelor's degree in nursing compared to the significant proportion of nurses who held a diploma degree (31.5%), and the small percentage of master's degree nurses (1.5%) which is consistent with the gradual academic upgrading of oncology nursing workforces across Middle Eastern health systems.[10]

Over half of the participants report that they only had 1-3 years' experience specifically in oncology units, reflect the frequent workforce instability and limited opportunities for long-term specialization of the oncology nurses observed in the low- and middle income health system.[11]

The urban concentration of the present sample (81.5%) is also significant from a health systems perspective, in line with the general trend of centralization of specialized oncology services in major urban hospitals.[12]

The findings of this study, however, that deeply rooted sociocultural and religious beliefs with respect to the linkage between pain experienced and underlying disease severity (M=2.50) and that suffering represents a test from God (M=2.37) are strongly congruent with previous ethnographic and qualitative research on how illness beliefs shape patients' willingness to report pain and how those beliefs affect nurses' interpretation of the reported pain in a variety of culturally conservative healthcare settings.[13]

The moderate level of institutional and resource based barriers identified in the present study, such as access to painkillers from outside the institution (M=2.15) and the authority of the prescription (M=2.12), is fairly similar to the results of the barriers in oncology setting reported in other Gulf and Middle Eastern healthcare system, where formulary restrictions and prescribing hierarchies have been identified as significant.[14]

The moderate barriers identified in this study: staff shortage(M=2.00), lack of assessment tools (M=1.96), and inadequate training programs (M=1.94) has been a recurrent finding in the research of nursing barriers in East Africa, which shows this factors recurring in barriers to systematic pain management practices in low-resource systems.[11]

This study reported that physicians consider the underlying illness to be more important than pain control (M=2.00), is in line with the literature describing the recurrent interprofessional power imbalance within oncology care teams, where nurses' observations and recommendations about pain are not always given clinical weight equal to physicians' diagnostics and curative priorities.[15]

The communication- and trust-related barriers identified among the lower end barriers in the present study, including (patients' reluctance to report pain, fear of being labelled a "complainer", and reluctance to ‘"annoy" the nurse), closely align with the central themes uncovered in qualitative studies on therapeutic communication barriers in nurse–patient relationships that show that asymmetries of trust, hierarchy, and

perceived social acceptability inhibit symptom disclosure.[16]

When compared to the general perception of sociocultural and institutional barriers to effective pain management discussed above, the agreement of the belief that "non-complaining" patients are viewed more favorably (M=1.6) and the perceived lack of available psychological support services (M=1.60) are relatively low. This suggests that while a significant minority of nurses recognize these aspects, they are typically less prominent than the more general areas of institutional and sociocultural barriers.[17]

According to the current findings, the majority of nurses (77%) reported moderate levels of perceived barriers, with a relatively small percentage reporting low (16.5%) and high (6.5%). Studies conducted in the Gulf region have shown a similar pattern, with the majority showing moderate levels of perceived barriers to cancer pain management among oncology nurses.[18]

The strong association found between governorate and overall barrier scores in the current study (p=0.000), with Karbala nurses reporting the highest perception and the lowest barrier scores, is notable and internally consistent, as it might suggest that the same set of institutional or training factors that enhance nurses' perception in Karbala also decrease their perceived barriers. This is supported by findings from a Chinese nursing study, which similarly indicated that facility-level differences in resourcing and institutional support can have a consistent effect on multiple dimensions of pain management perception and practice.[19]

The significant association between age group and barrier scores in the present study (p=0.018), with the oldest age group 40-49 years indicating the highest barrier scores, is similar to the significant association between oncology-unit experience and barrier scores (p=0.015), in which the highest scores were reported by the mid-tenure group of nurses, indicating a pattern of increasing, rather than decreasing, barrier scores over the course of nursing careers, a pattern reflecting findings from other research on oncology.[20]

A statistically significant association was found between pain management training and barrier scores in the present study (p=0.006), This further supports the idea that pain management training can positively influence both perception and barrier scores, as previously observed in a sample of Ethiopian oncology nurses, in which training exposure was similarly associated with significantly lower composite barrier scores compared to untrained counterparts.[21]

This study showed that there was no association between overall barrier scores and sex or residence, but academic qualification was associated with perception scores, highlights an important difference in the factors that influence these two outcome measures; in previous study of nurses' barriers to pain management in Nepal, factors related to knowledge (academic qualification), showed greater association with perception scores than with overall barrier scores.[22]

The association found between marital status and the barriers to pain management in the present study (Table 4), which was marginally significant at (p=0.053), with the divorced nurses having the highest perceived barriers.[7]

CONCLUSION

The developing and implementing educational and training programs as well as adopting standardized protocols for pain assessment and management, it also emphasized the significance of enhancing highlighted interdisciplinary collaboration, improving health education for patients and families, and resolving organizational and administrative barriers that hinder effective pain management in oncology units.

Recommendations: It is advised to adopt standardized protocols for the assessment and management of pain, as well as to develop and implement educational and training programs. It also improves patient and family health education, and removed administrative and organizational obstacles that prevent efficient pain management in oncology units.

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Original Article

Effect of Relapse Prevention Training Program on Nurses' Knowledge related to Addict Patients after Treatment

Hatem Kareem Mansoor[1] and Muna Abdulwahab Khaleel[2]

ABSTRACT

Objective: To assess the level of a relapse prevention on nurses' knowledge related to addicted patients after treatment.

Study Design: Descriptive study

Place and Duration of Study: This study was conducted at the teaching hospitals in Al-Hilla City Iraq from 15th June 2025 to 14th December 2025.

Methodology: A non-probability (convenience) sampling technique was used to reflect the general characteristics of the nurses and 50 nurses were enrolled.

Results: Overall nurse's knowledge toward relapse prevention related to addict patients, 48% of them poor and moderate level of knowledge and 48% of them have moderate level of knowledge too.

Conclusion: Poor and moderate level of knowledge that related to relapse prevention knowledge.

Key Words: Assessment, Nurse's knowledge, Relapse prevention, Addict patients

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INTRODUCTION

Substance use disorders (SUDs) continue to be a health issue in many parts of the world, and the high rate of relapse after treatment presents a significant burden to healthcare organizations.[1] Also states that about 35 million individuals throughout the world experience drug use disorders, and only 1 of every 7 individuals obtains the necessary treatment. Although some people show recovery, the relapse rates are still too high, and according to research, 40-60 percent of people relapse in the first year of treatment.[2] Nonetheless, the research indicates that a lot of nurses do not have sufficient training and knowledge skills to deal with the intricacies of addiction recovery.

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Recent cross-sectional research in Ethiopia also revealed that only a proportion of 48.3% of nurses were also good in terms of their knowledge on substance use care.[3,4]

Substance use disorder is a chronic, relapsing disease that has a huge burden on people, families, and medical systems all over the globe.[5] Although treatment is effective, the problem of relapse following treatment is an insurmountable obstacle to lasting recovery. Research has revealed that most patients receiving addiction treatment relapse in the first year, and in most cases, it is because of insufficient psychosocial support and relapse prevention measures.[6] Since addiction is a complicated issue with a multifaceted nature, relapse is no longer considered an act of moral failure but a certain predictive aspect of the process of recovery that needs specific interventions and qualified healthcare assistance.[7]

The concept of relapse is used to describe the re-emergence of substance use in people with SUD who have abstained or cut down on substance use. It is well known as a normal and clinically relevant phenomenon in the recovery process and not as a sign of moral failure or unsuccessful treatment. The Diagnostic and Statistical Manual of Mental Disorders defines substance use disorder by problematic pattern of substance use that causes clinically significant impairment or distress. In this context, relapse can be used to indicate the recurrence of symptoms and

functional deficiency following an improvement in status, which is indicative of the chronic and relapsing fact of addiction.[8]

Nurses operate at the leading line in the addiction recovery indicating medical and psychosocial assistance to the individuals after discharge. Nevertheless, research has shown that a lot of nurses are not well trained in the management of addictions and prevention of relapse. To illustrate, a recent report on Ethiopia indicated that only 48.3 per cent of nurses were knowledgeable enough when it comes to substance use care, and over 50 per cent showed misconceptions or negative views towards patients with SUDs.[3,9]

METHODOLOGY

This descriptive study was carried out at teaching hospitals in Al-Hilla City Iraq from 15th June 2025 to 14th December 2025 vide letter No. 85 dated 2nd June 2025. The non-probability (convenience) samples of 50 nurses were who employed in the addict care units of teaching hospitals. The information from the nurses about knowledge of them about relapse prevention related to addiction that is where all parts part fill by the nurses. The 1uestionnaires composed of six parts:

Part one include the demographical data of the nurses like age of the nurse who share in the study, sex, marital status, educational level, years of employment, and years of work in the psychiatric care unit.

Part two includes 13 questions that is used to assessment the level of knowledge of nurses regarding addiction and relapse, each question has four choices and the question was scored that one grade for correct answer and zero grade for incorrect answer.

Part three includes 14 question and information regarding the nurse knowledge related to assessment to prevent relapse each question has four choices and the question was scored that one grade for correct answer and zero grade for incorrect answer.

Part four includes 14 questions and information regarding the nurse knowledge related to assessment to prevent relapse each question has four choices and the question was scored that one grade for correct answer and zero grade for incorrect answer

Part five includes 12 questions and information regarding to psychosocial support, nurse-patient communication, and therapeutic relationships to prevent relapse each question has four choices and the question was scored that one grade for correct answer and zero grade for incorrect answer

Part six includes 26 questions and information regarding to clinical training plan for addiction-related relapse prevention each question has four choices and the question was scored that one grade for correct answer and zero grade for incorrect answer.

Rating and scoring of instrument of the study: 0-26 scores as grade of poor knowledge, 27-53 scores as grade of moderate knowledge and 54-79 scores as grade of good knowledge.

Reliability and validity of the instrument: The validity of the instrument of study had been achieved by experts from different scientific branches having at least 5 years of experience in their field of work mean of experiences. The validity of the study consists of (11 (expert that distributed as follow (experts of faculty of nursing university of Babylon, experts of Faculty of Nursing University of Kirkuk, experts of faculty of nursing university of Al-Mustaqbal university, experts of faculty of nursing university of Baghdad, Consultant physician from Babylon Health Department. All observation of the experts was taken in consideration to show the questionnaire in better status. The reliability of questionnaire is obtained questionnaire that include knowledge of nurses without demographical data the reliability of questionnaire includes 0.81 by used Cronbach's alpha test. The data was analyzed through SPSS-25.

RESULTS

There were approximately half of the females 54% and males 46%. Majority of participants 54% were aged between 25–30 years with mean age was 27.08±3.511 years.

Table No.1: Sociodemographic characteristics of sample (n=50)

Characteristics	No.	%
Gender		
Male	23	46.0
Female	27	54.0
Age (years)		
20-24	16	32.0
25-30	27	54.0
31-35	7	14.0
Marital status		
Single	24	48.0
Married	26	52.0
Widow	-	-
Divorced	-	-
Educational level		
Nursing School Graduated	-	-
Nursing Institute graduated	13	26.0
College of Nursing Graduated	37	64
Years of experience in nursing		
< 5	36	72.0
6-10	10	20.0
> 11	4	8.0
Years of experience in psychiatric units		
< 1	31	62.0
< 2	11	22.0
2-3	7	14.0
≥ 4	1	2.0

There were 52% of the nurses were married, 54% of the nurses graduated from a college of nursing. It was also

found that 72% of the participants had 5 years or less of nursing experience. About 62% of nurses had less than one year of experience in the psychiatric unit (Table 1). The mean scores are moderate in all domains (7.800, 7.960, 8.84, 9.08, 11.40, 42.0800). In overall, so moderate level assessment (Table 2).

48% of the participants had a poor level of knowledge, while another 48% had a moderate level of knowledge (Table 3). Regarding nurses' knowledge and sex, there is no significant difference between nurses' knowledge and sex (p=0.53) at the level of significance (p≤0.05). With respect to age, there is no significant difference between age and nurses' knowledge (p=0.632) at the level of significance (p≤0.05). However, the study results indicate a significant difference between nurses' knowledge and educational level (p=0.02) at the level of significance (p≤0.05) [Table 4]. Concerning years of experience in nursing, the results show that there is no significant difference between nurses' knowledge and years of experience in nursing (p=0.162) at the level of significance (p≤0.05).

Table No. 2: Descriptive statistics for study

Domain	Mean±SD	Assessment
Concept of addiction and relapse (range 5-10)	7.800±1.732	Moderate
Comprehensive assessment for relapse prevention (range 6-11)	7.9600±1.813	Moderate
Nursing interventions and relapse prevention strategies (range 4-12)	8.84±1.929	Good
Psychosocial support, nurse–patient communication, and the therapeutic relationship (range 7-12)	9.08±1.7058	Moderate
Clinical training plan for addiction-related relapse prevention (range 7-12)	11.40±3.662	Moderate
Overall (range 25-45)	42.0800±6.90	Moderate

Table No. 3: Overall nurse's knowledge study toward relapse prevention related to addict patients

Variable	Classes	Control	
		No.	%
Nurse's knowledge	Poor	24	48.0
	Moderate	24	48.0
	Good	2	4.0
	Minimum	25.00	
	Maximum	45.00	
	Mean ± SD	42.0800±6.90	
	Assessment	Moderate	

Poor = 0-26, Moderate = 27- 52, Good = 53-79

Table No. 4: Difference between demographic characteristics among study and nurse's knowledge toward relapse prevention related to addict patients

Socio-demographic characteristics		p. value	Statistic Test
Gender	Male	0.53	Mann-Whitney
	Female		
Age (years)	20-24	0.632	Kruskal-Wallis
	25-30		
	31-35		
Marital Status	Single	0.149	Kruskal-Wallis
	Married		
	Widow		
	Divorced		
Educational level	Nursing School Graduated	0.02	Kruskal-Wallis
	Nursing Institute graduated		
	College of Nursing Graduated		
Years of experience in nursing	≤ 5	0.162	Kruskal-Wallis
	6-10		
	> 11		
Years of experience in psychiatric unit	< 1	0.04	Kruskal-Wallis
	1-2		
	2-3		
	≥ 4		

DISCUSSION

In the present study, 48% of the participants had a poor level of knowledge, while another 48% had a moderate level of knowledge. This finding is consistent with that reported by Fisher et al[10] and Storm et al[11], which emphasizes that more interactive training methods should be implemented, as knowledge retention and practical skills are significantly improved through interactive teaching approaches such as role-playing.

The results of the present study show a significant difference between nurses' knowledge and years of experience in the psychiatric unit ($p=0.04$) at the level of significance ($p\leq0.05$). Barry et al[12] and Selby & Trinkoff[13] demonstrated that a higher level of education is associated with greater knowledge retention during addiction training. However, the researchers also found that a large proportion of participants (64%) had less than five years of nursing experience, and this factor did not have a significant influence on the results ($p=0.162$).

This study explained the psychiatric setting, 64% of participants had less than one year of experience, which showed a significant association ($p=0.04$). This highlights the importance of practical experience and is consistent with Chen et al[14], who suggested that limited experience in specialized fields may hinder the effective transfer of training knowledge. In contrast, Andersson and Nilsen[15] argued that knowledge can be effectively developed regardless of experience level, and that comprehensive training can help overcome knowledge gaps caused by limited experience.

CONCLUSION

Poor and moderate level of knowledge that related to relapse prevention knowledge.

Author's Contribution:

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Drafting or Revising Critically:	Hatem Kareem Mansoor, Muna Abdulwahab Khaleel
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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Original Article

Assessment of Transvaginal Ultrasound Predictive Features for Placenta Accreta Spectrum in Women with Previous Cesarean Scar

Rafal Hani Mustafa[1], Sulaf Saadi Hussein Al-Jailawi[2] and Farah Akram Al-Mahdawi[2]

ABSTRACT

Objective: To assess the transvaginal ultrasound examination to diagnose placenta accreta spectrum based on clear sonographic signs

Study Design: Descriptive study

Place and Duration of Study: This study was conducted at the Department of Radiology, College of Medicine, Al-Mustansiriyah University, Baghdad, Iraq, from 15th January 2026 to 30th May 2026.

Methodology: The study was conducted on 50 female patients who had previously undergone a cesarean section using ultrasound and color Doppler imaging.

Results: Ultrasound signs for diagnosing placenta accreta include: a reduced distance between the placenta and the uterus, disruption of the interface between the bladder and the uterus, the presence of placental lacunae (spaces), and increased blood flow surrounding the placenta.

Conclusion: Transvaginal ultrasound is a method for the early detection of placenta accreta.

Key Words: Placenta accreta spectrum, Transvaginal ultrasound, Cesarean scars, subplacental.

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INTRODUCTION

Placenta Accreta Spectrum (PAS) involves the attachment of the placenta to the uterine wall or the bladder, it occurs in pregnant women with a history of Cesarean sections and poses a serious risk if left undiagnosed or untreated.[1]

Recently, rates of cesarean section deliveries have increased. Current studies indicate that one in every 500 pregnancies among high-risk women is affected by this disorder. If the placental condition is not diagnosed prior to delivery, it can lead to serious complications—such as life-threatening hemorrhage and hysterectomy and may even result in maternal death.[2]

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Placenta accreta is diagnosed early by transvaginal ultrasound, and the earlier it is detected, the better the health outcomes for the mother.[3]

The incidence of placenta accreta spectrum increases in direct proportion to the number of prior uterine surgeries particularly previous Cesarean sections.[2]

Placenta previa is considered a major risk factor for placenta accreta spectrum, particularly in the presence of a prior cesarean scar. Additional risk factors include as advanced maternal age, multiparity, prior uterine surgeries, and assisted reproductive technologies.[4]

Placenta accreta spectrum is classified into three types; placenta accrete occurs when there is superficial attachment to the uterine muscle, placenta increta involves penetration or invasion of the uterine muscle and placenta percreta, where the placenta penetrates the uterine serosa and affects adjacent organs. The location of the placenta is significant for the health of both the mother and the fetus.[5]

This condition arises when a pre-existing scar from a previous cesarean section leads to a deficiency in the decidua, if implantation occurs at the site of the scar often associated with fibrosis, the likelihood of abnormal placental attachment increases and this risk rises with each subsequent procedure.[1]

Although ultrasound is the primary imaging modality but magnetic resonance imaging (MRI) is used in cases where ultrasound findings are inconclusive or when placental implantation in the posterior part of the uterus is suspected. In early pregnancy the transvaginal ultrasound is considered more accurate.[6]

Clear MRI signs for diagnosing placenta accreta include reduction of the hypoechoic clear zone, the presence of multiple placental lacunae, and thinning of the uterine muscle. The greater the number of radiological signs present, the higher the diagnostic accuracy. Color Doppler imaging used alongside transvaginal ultrasound, is significant as it reveals bridging blood vessels, increased sub-placental vascularity and turbulent flow within vascular lacunae.[5]

The purpose of this study is to focuses on diagnosing placenta accreta spectrum in pregnant women with scars from previous cesarean sections using transvaginal ultrasound.

METHODOLOGY

This descriptive study was carried out at the Ultrasound unit of the Department of Radiology from a private medical center during the period from 15th January 2026 to 30th May 2026 reference number 18 dated 1st January 2026 and 50 pregnant women who visited the ultrasound unit were enrolled. Cases were selected based on pregnant women with a history of prior surgeries, they underwent prenatal ultrasound examinations to determine the location and position of the placenta, as these patients face an increased risk of placenta accreta due to the presence of a uterine scar.

All pregnant woman with a history of previous cesarean sections, gestational age of 12 weeks or more, placenta located in the lower part of the uterus and single fetus pregnancy were included. Multiple pregnancies, congenital uterine anomalies, unclear imaging data were excluded.

Information collected from the pregnant women included: maternal age, number of pregnancies and deliveries, number of previous Caesarean sections and any history of placenta previa. Pregnant women underwent transabdominal ultrasound to assess fetal viability, determine gestational age, evaluate placental location, and measure amniotic fluid volume. Transvaginal ultrasound was performed to determine the site of placental implantation with greater precision.

The transvaginal probe operates at a high frequency ranging from 5 to 9 MHz. The examination is performed after the bladder has been emptied, with the pregnant woman positioned in the lithotomy position (lying on her back with her legs raised). The gray-scale imaging signs indicative of placenta accreta include thinning of the retroplacental clear zone (appearing hypoechoic), presence of multiple, irregular placental lacunae, thinning of the myometrium at the placental implantation site (thickness <5 mm), abnormalities of the uterine contour and disruption of the interface between the uterus and the bladder

Notable signs observed via Color Doppler imaging include: the presence of blood vessels extending from the placenta to the uterine serosa; a marked increase in blood flow in the area where the placenta attaches to the uterus; and increased blood flow at the site of placental implantation over the Cesarean section scar. These signs serve as indicators for diagnosing placenta accreta spectrum.

Diagnostic criteria: The presence of two ultrasound signs is considered an indicator of placenta accreta spectrum, even if color Doppler imaging results are normal. The definitive diagnosis is established through intraoperative observations during delivery and/or via hysterectomy and histological examination.

The pregnant woman for the third time with a history of two previous cesarean sections, was diagnosed with placenta accreta following a transvaginal ultrasound that revealed a low-lying placenta and a reduced distance between the placenta and the uterus (Fig. 1). The data was entered and analyzed through SPSS-26.

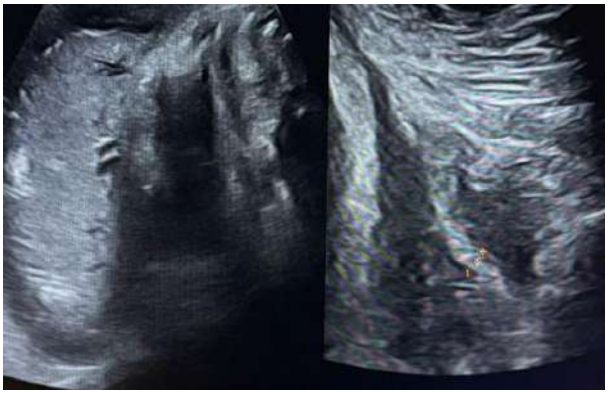


Figure No. 1: Pregnant woman for the third time with a history of two previous cesarean sections

RESULTS

Table 1 illustrates the necessity of using color Doppler with intracranial ultrasound, as it increases the sensitivity to 90%. Table 2 showed that diagnosis via transvaginal ultrasound is more valuable than magnetic resonance imaging. The ultrasound signs for diagnosing placenta accreta are a reduced distance between the placenta and the uterus, accompanied by the presence of placental lacunae (Table 3).

Ultrasound imaging reveals the specific type of placental adhesion. Among these types":placenta accreta" is diagnosed by the disappearance of the clear interface zone. "Placenta increta" appears as marked thinning of the uterine muscle, accompanied by blood vessels extending through it. "placenta percreta" presents various ultrasound signs, such as placental protrusion and extension toward the bladder, so transvaginal ultrasound examination is essential (Table 4).

Table No. 1: Predictive TVU features of PAS

Feature	Descriptive	Diagnostic value
Loss of clear zone	Disappearance of the hypoechoic line between placenta and myometrium	High sensitivity
Myometrial thinning	Myometrium <1 mm under the placental bed	Moderate sensitivity
Placental lacunae	Irregular vascular spaces within placenta	High specificity
Bladder-uterine interface disruption	Loss of hyperechoic bladder wall line	High specificity
Bridging vessels	Vessels crossing from placenta to bladder	Specific for invasive PAS
Subplacental hypervascularity	Turbulent color Dopper flow	Good sensitivity
Placental bulge	Outward contour deformity of uterus	Suggestive of percreta

Table No. 2: Comparison of TVU and MRI in PAS diagnosis

Parameter	TVU	MRI
Accessibility	Widely available, cost-effective	Limited availability, expensive
Resolution	High resolution for lower uterine segment	Excellent soft tissue delineation
Detection of PAS	High sensitivity and specificity	Comparable accuracy, useful adjunct
Operator dependence	High (requires skilled examiner)	Moderate
Use in 1st trimester	Possible for early PAS signs	Limited role
Use in bladder invasion	Less reliable	Superior assessment of percreta

Table No. 3: Summary of clinical cases (n=50)

Patient Group	No. of Cases	Main TVU Features	Final Diagnosis
Placenta accrete vera	20	Loss of clear zone, mild lacunae	Confirmed accreta
Placenta increta	15	Myometrial thinning, bridging vessels	Confirmed increta
Placenta percreta	10	Placental buldge, bladder wall invasion	Confirmed percreta
Normal cerarean scar placenta	5	Intact myometrium, no abnormal lacunae	Excluded PAS

Table No. 4: Sensitivity and specificity of key TVU features

TVU Feature	Sensitivity	Specificity
Loss of clear zone	77-85%	90-90%
Myometrial thinning <1mm	70-82%	75-88%
Placental lacunae	80-93%	85-93%
Bladder-uterine interface disruption	65-80%	90-95%
Bridging vessels	60-75%	88-95%
Subplacental hypervasculaity	78-90%	80-90%
Placental bulge	55-70%	90-96%

DISCUSSION

Placental adherence poses a risk to the health of both the mother and the fetus particularly in women who have undergone previous surgeries. Transvaginal ultrasound is the method for early detection of placental adherence; this aligns with the findings of a study by D'Antonio et al[3], which demonstrated that ultrasound imaging supplemented by color Doppler can detect placental adherence prior to delivery.

A link exists between placental lacunae and histologically confirmed placental adherence a finding corroborated by Cali et al[5] consistent with the current study's conclusion that placental lacunae serve as an indicator of placental adherence.

The reduced distance between the placenta and the uterus is associated with placental adhesion, consistent with the findings of the study by Jauniaux et al[7], which demonstrated a relationship between myometrial thickness and placental implantation.

Color Doppler imaging revealed specific patterns specifically, increased blood flow in the region beneath the placenta, observed in multiple cases that had previously been described by Collins et al[8] and Morel et al[9] in their studies of (placenta increta and placenta percreta). The presence of blood flow within placental lacunae, the proximity of the placenta to the uterus, and increased intraoperative blood loss were identified as signs of placental adherence consistent with the findings of a studies by Zhang et al[10] and Vahdani et al.[11]

The necessity of using color Doppler and transvaginal ultrasound for the early diagnosis of placenta accreta spectrum disorders is supported by the findings of D'Antonio et al.[3] A single ultrasound sign is insufficient for diagnosis; rather, the presence of two or more signs is required for an accurate diagnosis consistent with the work of Shih et al[12] and Zhang et al[13], who established criteria linking 2D ultrasound findings with Doppler examination results.

The small sample size and reliance on routine clinical data from a single medical center are among the limitations of this study. This aligns with the findings of Bowes et al[14] and Kirovakov et al[15], they highlighted the need to balance broad applicability with practical challenges. The importance of placental assessment using transvaginal ultrasound and color Doppler particularly in cases of prior cesarean section cannot be overstated, as it serves to protect the maternal uterus. Further large-scale studies are recommended to investigate placental adhesion.

CONCLUSION

Transvaginal ultrasound plays a crucial role in detecting placental adhesion and identifying its three types in women with a history of cesarean sections by visualizing specific imaging markers, thereby reducing risks and safeguarding maternal health.

Author's Contribution:

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Original Article

A Comparison of Oral Health Status, Traumatic Dental Injury and Tooth Wear between Autistic and Healthy Children

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ABSTRACT

Objective: To assess and compare the oral health condition, caries experience, traumatic dental injuries, and tooth wear of autism spectrum disorder children with those of the healthy control group

Study Design: Comparative cross-sectional study

Place and Duration of Study: This study was conducted at the College of Dentistry, University of Kufa, Iraq, from 1st October 2025 to 28th February 2026.

Methodology: The study was conducted on children diagnosed with autism spectrum disorder and a healthy control group who participated in the study. Oral health examination was done using global oral health indicators. Oral hygiene and periodontal status were assessed using the Plaque index (PI), Gingival index (GI), and Calculus index (CI). Dental caries were assessed using the Decayed, Missing, and Filled Teeth (DMFT) and Decayed, Missing, and Filled Surfaces (DMFS) indexes. Data concerning traumatic dental injuries and tooth wear were collected.

Results: Oral health condition was found to be poor among the autism spectrum disorder group when compared with the healthy control group. The former had a significantly higher plaque, gingival, and calculus index when compared with the latter ($P < 0.05$). In addition, there was a significant difference in caries experience (DMFT and DMFS) between the two groups, with a higher Decayed, Missing, and Filled Teeth and Decayed, Missing, and Filled Surfaces being recorded in the autism spectrum disorder group. However, there was no significant difference in caries experience of permanent teeth (DMFT and DMFS) between the two groups; the overall mean Decayed, Missing, and Filled Teeth was significantly higher in the autism spectrum disorder group. Traumatic dental injuries and tooth wear were significantly higher in the autism spectrum disorder group. Males had a higher prevalence of traumatic dental injuries, whereas females with autism spectrum disorder had a higher prevalence of tooth wear

Conclusion: The oral health condition of children with autism spectrum disorder was found to be poor when compared with that of the healthy control group. The former had poor oral hygiene, higher gingival inflammation indices, poor caries experience of the primary teeth, and a higher prevalence of traumatic dental injuries and tooth wear.

Key Words: Autism spectrum disorder, Oral health, Dental caries, Plaque index, Gingival index, Tooth wear.

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INTRODUCTION

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Autism spectrum disorder (ASD) is a heterogeneous neurodevelopmental disorder characterized by persistent deficits in social communication and social interaction, accompanied by restricted, repetitive patterns of behavior, interests, or activities.[1] It has been well known that ASD is a multifactorial psychiatric condition and a combination of three developmental, environmental and genetic factors is introduced as the etiology of this disorder.[2] Early signs of autism appear in infants as young as 6 months, the signs of this disorder are then stabilized by age 2-3 years, and then tend to continue through adulthood, boys are 3.7 times more likely to be autistic than girls.[3] The global prevalence of ASD has increased considerably over the

past two decades, with recent surveillance data estimating that approximately 1 in 36 children is diagnosed with ASD, highlighting its growing public health significance.[4]

Children with ASD often experience considerable challenges in maintaining adequate oral health because of impaired communication, behavioral difficulties, sensory hypersensitivity, limited manual dexterity, and poor cooperation during oral hygiene procedures and dental treatment.[5] In addition, food selectivity, frequent consumption of cariogenic diets, parafunctional oral habits, medication-induced xerostomia, and limited access to specialized dental services may further increase their susceptibility to oral diseases.[6]

The oral health condition of children with ASD, significantly higher levels of dental plaque, gingival inflammation, untreated dental caries, and poor oral hygiene compared with healthy children.[7] Conversely, other studies have found no significant differences in caries prevalence between children with ASD and their typically developing peers, suggesting that oral health outcomes may be influenced by socioeconomic factors, caregiver education, dietary habits, access to dental care, and methodological differences among studies.[8]

Traumatic dental injuries (TDIs) constitute another important oral health problem among children with ASD. Motor coordination deficits, hyperactivity, impulsive behavior, self-injurious habits, and reduced awareness of environmental hazards may increase the likelihood of dental trauma in this population.[9] The communication difficulties may delay recognition of traumatic injuries and prevent timely dental intervention, thereby increasing the risk of long-term functional and esthetic complications.[10]

Tooth wear is increasingly recognized as an important oral condition among children with ASD. Bruxism, repetitive chewing behaviors, object biting, gastroesophageal reflux, dietary acids, and medication-related xerostomia may accelerate the progressive loss of dental hard tissues.[11] However, the prevalence and severity of tooth wear in children with ASD is poorly understood and remains inconsistent in the literature.[12]

The oral condition of children with ASD in Europe, North America, and some Asian countries, there is a lack of information on oral health status in Iraq.[13] A variation in health care resources, socioeconomic conditions, oral health status, health behaviors, diet, and access to oral health services may affect oral health status and should be considered for the study population in Iraq. Therefore, the present study aimed to compare the oral health condition, traumatic dental injury, and tooth wear of children with autism spectrum disorder and healthy children in Najaf City, Iraq.

METHODOLOGY

This comparative cross-sectional study was conducted at the College of Dentistry, University of Kufa, Iraq, from October 2025 to February 2026. It included 159 children with ASD (105 males, 54 females) and 300 controls (215 males, 85 females). Children with ASD were recruited from autism rehabilitation centers and special needs schools; controls were randomly selected from local government primary schools. Administrative permissions and parental or guardian consent were obtained, and procedures followed the Declaration of Helsinki.[14]

Eligibility specified children aged 6–12 years. ASD diagnoses were established by pediatric neurologists or psychiatrists using the Diagnostic and Statistical Manual of Mental Disorders.[15] Controls had no neurodevelopmental disorders. Exclusion criteria included neurological or systemic conditions affecting oral health, craniofacial anomalies, inability to complete examination, and absent parental consent.

A calibrated pediatric dentist performed examinations using standard dental instruments and portable illumination. Caries was assessed using WHO criteria for primary and permanent dentition.[16] Plaque, gingival, and calculus indices assessed oral hygiene and gingival health. TDIs were classified using McDonald and Avery criteria[17] and tooth wear using the Bardsley index.[18] Data were analyzed using SPSS version 27, with Mann-Whitney U tests for nonnormally distributed continuous variables and chi-square tests for categorical variables. Statistical significance was set at $p<0.05$.

RESULTS

The largest age group was 7–9 years in both populations (Table 1). Plaque scores were higher in children with ASD aged 4–6 and 7–9 years (both $p < 0.001$), but the difference was nonsignificant at 10–12 years ($p = 0.156$). Gingival and calculus indices were significantly higher across all age groups (Table 2).

TDIs affected 33/159 children with ASD (20.8%) and 34/300 controls (11.3%; p=0.007). The difference was significant among males (21.9% versus 12.1%; p=0.022), but not females (18.5% versus 9.4%; $p = 0.119$; Table 3). Tooth wear affected 67/159 children with ASD (42.1%) and 33/300 controls (11.0%), with significant differences overall and within both sexes (all $p < 0.001$; Table 4).

Primary-dentition caries experience was higher in the ASD group, with median dmfs scores of 11 versus 9 (p=0.003) and dmft scores of 5 versus 4 ($p<0.001$); differences were significant within both sexes. Permanent-dentition DMFS did not differ significantly overall (p=0.054), whereas DMFT was significantly higher overall (p=0.040), despite identical medians of 2 and nonsignificant sex-specific comparisons (Tables 5-6).

Table No. 1: Distribution of the study population according to age group and sex

Age (years)	Study Group			Control Group		
	Male	Female	Total	Male	Female	Total
4-6	41	14	55	61	19	80
7-9	49	24	73	96	43	139
10-12	15	16	31	58	23	81
Total	105	54	159	215	85	300

Table No. 2: Comparison of plaque index, gingival index and calculus index scores between children with autism spectrum disorder and healthy controls according to age group

Plaque Index Scores				
Age group (years)	**Study Group**	**Control Group**	**Statistical Sig.**	
	Median of PII	**Median of PII**	**Mann-Whitney**	**P value**
4-6	1.60	0.55	811.000	0.001**<
7-9	1.60	1	2124.000	0.001**<
10-12	1.60	0.80	1040.000	0.156
Gingival Index Scores				
Age group (years)	**Study Group**	**Control Group**	**Statistical Sig.**	
	Median of GI	**Median of GI**	**Mann-Whitney**	**P value**
4-6	1.60	0.80	866.500	0.001**<
7-9	1.70	0.30	1639.000	0.001**<
10-12	1.50	0.90	808.000	0.003**
Calculus index scores				
Age group (years)	**Study Group**	**Control Group**	**Statistical Sig.**	
	Median of CI	**Median of CI**	**Mann-Whitney**	**P value**
4-6	1.60	-	659.000	0.001**<
7-9	1.60	-	1193.500	0.001**<
10-12	1.50	0.60	552.500	0.001**<

Table No. 3: Distribution of traumatic dental injuries among children with autism spectrum disorder and healthy controls according to sex

Gender	**Study Group**			**Control Group**			**Statistical Sig.**	
	Total	**With Trauma**		**Total**	**With Trauma**		**X^2**	**P value**
		No.	**%**		**No.**	**%**		
Male	105	23	21.9	215	26	12.1	5.237	0.022*
Female	54	10	18.5	85	8	9.4	2.429	0.119
Total	159	33	20.8	300	34	11.3	7.399	0.007*

Table No. 4: Distribution of tooth wear among children with autism spectrum disorder and healthy controls according to sex

Gender	**Study Group**			**Control Group**			**Statistical Sig.**	
	Total	**With Tooth Wear**		**Total**	**With Tooth Wear**		**X^2**	**P value**
		No.	**%**		**No.**	**%**		
Male	105	37	35.2	215	26	12.1	23.901	0.001**<
Female	54	30	55.6	85	7	8.2	37.855	0.001**<
Total	159	67	42.1	300	33	11.0	59.133	0.001**<

Table No. 5: Comparison of caries experience DMFS of primary and permanent teeth between children with autism spectrum disorder and healthy controls according to sex

Gender	**Study Group**			**Control Group**			**Statistical Sig.**	
	Total	**DMFS**		**Total**	**DMFS**		**X^2**	**P value**
		Median	**Mean Rank**		**Median**	**Mean Rank**		
Primary Teeth								
Male	105	10	175.41	215	9	153.22	9721.500	0.043*
Female	54	11.5	79.76	85	9	63.80	1768.000	0.023*
Total	159	11	255.25	300	9	216.62	19835.000	0.003**
Permanent Teeth								
Male	105	2	167.09	215	2	157.28	10596.000	0.362
Female	54	4.5	77.67	85	3	65.13	1881.000	0.071
Total	159	2	246.11	300	2	221.46	21289.000	0.054

Table No. 6: Comparison of caries experience DMFT of primary and permanent teeth between children with autism spectrum disorder and healthy controls according to sex

Gender	Study Group			Control Group			Statistical Sig.	
	Total	DMFT		Total	DMFT		Mann-Whitney	P value
		Median	Mean Rank		Median	Mean Rank		
Primary Teeth								
Male	105	5	194.61	215	4	143.84	7705.500	0.001**<
Female	54	5	84.63	85	4	60.71	1505.000	0.001**
Total	159	5	278.59	300	4	204.25	16124.000	0.001**<
Permanent Teeth								
Male	105	2	167.82	215	2	156.93	10519.000	0.309
Female	54	3	77.92	85	2	64.97	1867.500	0.061
Total	159	2	247.10	300	2	220.94	21131	0.040*

DISCUSSION

In the present study, children with ASD tend to have poorer oral health status than their healthy peers, as evidenced by higher plaque, gingival inflammation levels, number of calculus, experience of caries in primary dentition, and prevalence of traumatic dental injury and tooth wear. This indicates that children with ASD are a vulnerable population that requires developing tailored preventive measures against dental diseases. Children with ASD had significantly higher plaque indices than typically developing children, which was consistent with a previous body of research reporting on compromised oral hygiene in children with ASD.[19,20] The higher plaque indices are explained by numerous factors associated with ASD, including decreased fine motor skills, impaired tactile senses, challenging behaviors, noncompliance with toothbrushing procedures, and parental involvement in oral hygiene. Resistance to tooth brushing because of tactile sensitivity and altered sensory processing further contributes to persistent plaque accumulation.

Consistent with the increased plaque scores, children with ASD exhibited significantly poorer gingival health than healthy controls. Gingival inflammation is primarily plaque-induced and reflects inadequate oral hygiene practices. Similar findings have been consistently reported in recent systematic reviews and meta-analyses demonstrating a higher prevalence of gingivitis and periodontal disease among children with ASD than neurotypical peers.[21,22] Besides plaque accumulation, dietary preferences, sensory hypersensitivity, limited cooperation, and caregiver-related factors may further contribute to poor periodontal health.[23]

The calculus index was also significantly higher among children with ASD, suggesting prolonged plaque retention and inadequate long-term plaque control. Similar findings have been reported in Iraq and neighboring countries.[24] No significant differences in calculus accumulation, indicating that socioeconomic status, caregiver education, oral health awareness, and access to preventive dental services may substantially influence calculus formation.[25]

Regarding dental caries, children with ASD exhibited significantly higher DMFT scores than healthy controls, indicating a greater burden of disease in the primary dentition. In contrast, no significant differences were found in DMFS, which were only moderately, but significantly, higher in the ASD group. These results suggest that the caries experience gap is more prominent during the early mixed dentition and before the permanent dentition erupts. Increased caries experience in children and adolescents with ASD is consistent with Zhou et al.[26] Several factors contribute to caries development among people with ASD such as poor plaque control, selective eating with frequent intake of soft carbohydrate-dense food, extended eating periods, less frequent dental visits, and decreased ability to cooperate during dental procedures, and reduced utilization of preventive dental services. Drugs that can be prescribed for behavioral or neurological disorders can decrease salivary flow, resulting in decreased protection of the teeth from caries-developing bacteria.[23]

Children with ASD were more likely to have traumatic dental injuries compared to healthy counterparts confirmed by the study. This result aligns with previous studies heightened the risk of dental trauma among children with ASD.[27] The contributing factors for the development of traumatic injuries may include challenges in fine and gross motor skills, hyperactivity, and stereotyped behaviors, self-injurious activities, increased risk of falling, and occurrence of epileptic seizures, and reduced awareness of the surroundings. In addition, boys with ASD were more likely to be affected by TDI compared to girls, which may be explained by the fact that children with ASD are more likely to participate in physically demanding activities, and boys are more active than girls, therefore, are more likely to be exposed to accidental injuries.[25]

Tooth wear was also found to be significantly higher among children with ASD. The reason for this is that ASD was previously associated with parafunctional oral

habits such as bruxism, clenching, masticatory movements, and biting objects. Bruxism seems to be a common manifestation in children with ASD that is often related to anxiety, sleep disorders, behavioral problems, and the use of specific drugs. Parafunctional activity such as bruxism damages enamel and dentin, contributing to extensive tooth wear.[28]

CONCLUSION

Children with autism spectrum disorder exhibited a significantly greater caries experience in the primary dentition than healthy controls. Oral hygiene status and gingival health were significantly poorer among children with ASD, as reflected by higher plaque accumulation and gingival inflammation. The prevalence of traumatic dental injuries was significantly higher in the ASD group than in the control group, with male participants showing a higher frequency of traumatic dental injuries than females in both groups. Tooth wear was also significantly more prevalent among children with ASD than healthy controls; within the ASD group, female participants exhibited a significantly higher prevalence of tooth wear than males.

Author's Contribution:

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Original Article

Balloon-Blowing Versus Deep-Breathing Exercises for Dyspnea in Pediatric Congenital Heart Diseases: A Randomized Controlled Study

Marwa Nayef Khassaf Abass[1] and Khatam Mutasher Hattab[2]

ABSTRACT

Objective: To compare balloon-blowing and standard deep-breathing exercises for reducing dyspnea in children with congenital heart disease

Study Design: Multicenter, parallel randomized controlled study

Place and Duration of Study: This study was conducted at the Bent Al-Huda Teaching Hospital, Mohammed Al-Mousawi Children's Hospital and Nasiriyah Heart Hospital in Al-Naseria City, Iraq, from 15th March 2026 to 14th June 2026.

Methodology: Sixty-three children were equally allocated to balloon blowing (n=21), deep breathing (n=21), or control (n=21). Data were collected using a structured questionnaire, clinical assessment, and the Modified Borg Dyspnea Scale.

Results: Most participants were aged 3–5 years, with no significant age difference between groups (χ^2=0.41, p=0.982). Sex distribution was comparable. Ventricular septal defects occurred in 28.6% of children in both the balloon-blowing and control groups. Baseline dyspnea scores did not differ significantly (χ^2=0.18, p=0.914). At 30 minutes post-exercise, a significant difference in dyspnea was observed among the three groups (χ^2=10.92, p<0.004).

Conclusion: Balloon blowing and deep breathing showed comparable effectiveness in reducing dyspnea, with no significant difference between the two techniques. Both may be incorporated into routine respiratory care for children with congenital heart disease.

Key Words: Balloon-blowing, Deep-breathing exercises, Congenital heart disease.

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INTRODUCTION

Pediatric congenital heart disease (CHD) comprises structural abnormalities of the heart or great vessels present at birth and may cause persistent dyspnea, impaired breathing patterns, and reduced exercise tolerance.[1] In Baghdad, congenital anomalies were reported more frequently among male (60%) and preterm (48.3%) neonates, with cardiovascular anomalies accounting for 26.7% of cases.[2] Children with congenital disorders may also experience psychosocial and behavioral problems.[3] Respiratory dysfunction can additionally impair sleep quality and overall well-being.

Chronic deoxygenation and cardiopulmonary remodeling in CHD may impair respiratory muscle function and contribute to exercise limitation. Deep-breathing exercises improve diaphragmatic expansion, tidal volume, and alveolar ventilation, but adherence may be difficult in children. Balloon blowing provides a play-based alternative involving deep inhalation and resisted exhalation.[4] Both techniques may improve respiratory muscle function and oxygenation, although comparative evidence in pediatric cardiology remains limited.[5] Improvements in cardiorespiratory parameters have also been demonstrated with supportive respiratory interventions in pediatric populations.[6] Resistive blowing techniques may improve respiratory

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mechanics and reduce breathlessness.[7] Therefore, this study compared balloon-blowing and deep-breathing exercises for reducing dyspnea in children with CHD.

METHODOLOGY

A multicenter, parallel randomized controlled trial was conducted in three hospitals in Al-Naseria City: Bent Al-Huda Teaching Hospital, Mohammed Al-Mousawi Children's Hospital, and Nasiriyah Heart Hospital from 15th March 2026 to 14th June 2026 letter No. 98 dated 4th March 2026. The study compared three groups: balloon-blowing exercise, deep-breathing exercise, and routine-care control. A total of 63 children with congenital heart disease were enrolled and equally allocated to the balloon-blowing (n=21), deep-breathing (n=21), and control (n=21) groups. Eligible participants were assigned serial numbers from 1 to 63 for identification. Group allocation was performed using sealed envelopes containing numbers 1, 2, or 3, corresponding to the three study groups. Allocation information was accessible only to an independent assistant and concealed from those involved in recruitment and assessment.

Data were collected through a structured questionnaire and direct observation. The questionnaire included demographic characteristics, clinical information regarding congenital heart disease, previous hospitalization or cardiac surgery, physical activity, and previous balloon-blowing practice. Dyspnea severity was assessed using the Modified Borg Dyspnea Scale ranging from 0 (no breathlessness) to 10 (maximum breathlessness).

Children in the balloon-blowing group performed deep nasal inhalation followed by slow exhalation into a balloon for 5–10 repetitions per session. The deep-breathing group performed nasal inhalation for 3–5 seconds, held the breath for 2 seconds, and slowly exhaled through the mouth for 5–10 repetitions. Both interventions were performed twice daily for 10–15 minutes over two consecutive days. The control group received routine nursing and medical care without additional respiratory exercises.

The primary assessments included oxygen saturation (SpO_2), dyspnea severity, respiratory rate, and heart rate. SpO_2 and heart rate were measured using a pulse oximeter, respiratory rate by direct observation, and dyspnea using the Modified Borg Scale. On each study day, measurements were obtained before the first intervention (T1), immediately after it (T2), 30 minutes later (T3), and immediately after the second intervention (T4). The same schedule was repeated on day 2, resulting in eight assessment points per participant. Measurements were performed using standardized procedures under similar environmental conditions and, whenever possible, at comparable times of day.

Data were analyzed using SPSS-24. Descriptive and inferential statistical methods were used to evaluate baseline characteristics, between-group differences, within-group changes, and overall intervention effects.

RESULTS

Most children were aged 3–5 years, with no significant difference between groups (χ^2=0.41, p=0.982). Sex (χ^2=0.19, p=0.909) and residence (χ^2=0.18, p=0.914) were also comparable. Nuclear families were most common, with no significant difference in family type (χ^2=1.02, p=0.795). Maternal and paternal education and occupation were similarly distributed across groups (all p>0.05). Most mothers were housewives, while fathers were predominantly employed in government or private/free-work occupations (Table 1).

Of the three groups in the study, the most frequently diagnosed type of congenital heart disease was Ventricular Septal Defect (VSD). Twenty-eight percent of the total number of children included was either in the balloon blowing group or the control group had VSD. In the deep breathing group, 24 percent had VSD. Atrial Septal Defect (ASD) was diagnosed in approximately 14 percent of each of the groups while; Patent Ductus Arteriosus (PDA) was diagnosed in 10 percent of the participants in all three groups (i.e, gradual reduction of malalignment of ventricular septa). Amongst the children diagnosed with a cyanotic defect, Tetralogy of Fallot was the most commonly diagnosed defect across all three groups (approximately 24% of children per group). The next two most frequently diagnosed cyanotic defects were Transposition of the Great Arteries (approximately 10% of children in each group) and Tricuspid Atresia (approximately 5% of children in each group). The prevalence of acyanotic versus cyanotic defects in the balloon blowing, deep breathing, and control groups were 62%, 57%, and 62% for acyanotic defects; and 38%, 43% and 38% for cyanotic defects respectively (Table 2).

Baseline Modified Borg Dyspnea Scale scores were similar across the balloon-blowing, deep-breathing, and control groups (n=63). Most children had mild dyspnea (scores 1–2), while fewer reported very mild (0–0.5), moderate (3), or higher scores (≥4). No significant baseline difference was observed among the groups (Kruskal–Wallis χ^2=0.18, p=0.914), confirming comparable initial dyspnea severity. Immediately after intervention, moderate dyspnea scores (3-4) were more frequent in the balloon-blowing and deep-breathing groups, whereas the control group showed more scores in the 1-2 range. However, the difference among the three groups was not statistically significant (Kruskal–Wallis χ^2=2.18, p=0.702), indicating comparable immediate post-exercise dyspnea severity. At 30 minutes post-exercise, the Modified Borg Dyspnea Scale showed clear differences among the three groups. Children in the balloon-blowing and deep-breathing

groups had more scores in the 0-0.5 range, indicating lower dyspnea, whereas the control group had more moderate-to-high scores, including scores of 4–10. The difference among groups was statistically significant (Kruskal–Wallis χ^2=10.92, p<0.004), demonstrating a significant improvement in dyspnea after the respiratory interventions (Table 3).

The mean Borg dyspnea scores for the balloon blowing and deep breathing groups differed across four time points (n = 42), as presented in Table 6. There was little difference in the dyspnea scores of the two groups at baseline (T1), with values for balloon blowing and deep breathing at 1.74±1.1 and 1.88±1.2; respectively. At T2, both groups had a marked increase in their dyspnea scores, with means of 3.12±1.4 for balloon blowing and 3.05±1.3 for deep breathing. At T3, both groups showed a decline in their dyspnea scores, with 1.02 ± 0.9 and 1.10±0.8 for balloon blowing and deep breathing, respectively. Finally, at T4, both groups had further decreased their dyspnea scores to less than 0.5, balloon blowing (0.48±0.6) and deep breathing (0.52±0.5) [Table 4].

The overall effectiveness of Balloon Blowing and Deep Breathing Exercises in relation to acute and chronic conditions has been examined, and the results show similar performance between the two groups for all measured variables. There was not a statistically significant difference between the two groups on any variable. For example, thedyspnea scores (Borge scale) between the two groups had very little difference as well as the indicating both groups had similar physiological responses (Table 5).

Table No. 1: Distribution of study sample by socio-demographic variables across study groups (n = 63)

Variable	Category	Balloon Blowing n (%)	Deep Breathing n (%)	Control n (%)	χ^2	p-value
Age (years)	3–5	13 (61.9)	12 (57.1)	12 (57.1)	0.41	0.982
	6–8	8 (38.1)	9 (42.9)	9 (42.9)		
Sex	Male	11 (52.4)	10 (47.6)	11 (52.4)	0.19	0.909
	Female	10 (47.6)	11 (52.4)	10 (47.6)		
Residence	Urban	14 (66.7)	13 (61.9)	13 (61.9)	0.18	0.914
	Rural	7 (33.3)	8 (38.1)	8 (38.1)		
Family Type	Nuclear	12 (57.1)	11 (52.4)	11 (52.4)	1.02	0.795
	Extended	6 (28.6)	7 (33.3)	7 (33.3)		
	Single parent	2 (9.5)	2 (9.5)	2 (9.5)		
	Grandparent	1 (4.8)	1 (4.8)	1 (4.8)		
Maternal Education	Low (Primary/Intermediate)	10 (47.6)	11 (52.4)	11 (52.4)	0.28	0.963
	High (Secondary+)	11 (52.4)	10 (47.6)	10 (47.6)		
Paternal Education	Low	9 (42.9)	10 (47.6)	10 (47.6)	0.31	0.958
	High	12 (57.1)	11 (52.4)	11 (52.4)		
Maternal Occupation	Housewife	14 (66.7)	15 (71.4)	15 (71.4)	0.22	0.973
	Employed	7 (33.3)	6 (28.6)	6 (28.6)		
Paternal Occupation	Government/Free work	15 (71.4)	14 (66.7)	14 (66.7)	0.33	0.955
	Unemployed/Retired	6 (28.6)	7 (33.3)	7 (33.3)		

Table No. 2: distribution of diagnosed congenital heart diseases across study groups (n=63)

Type of Congenital Heart Disease	Balloon Blowing n (%)	Deep Breathing n (%)	Control n (%)
Acyanotic Defects			
Ventricular Septal Defect (VSD)	6 (28.6)	5 (23.8)	6 (28.6)
Atrial Septal Defect (ASD)	3 (14.3)	3 (14.3)	3 (14.3)
Patent Ductus Arteriosus (PDA)	2 (9.5)	2 (9.5)	2 (9.5)
Atrioventricular Septal Defect (AVSD)	1 (4.8)	1 (4.8)	1 (4.8)
Pulmonary Stenosis	1 (4.8)	1 (4.8)	1 (4.8)
Coarctation of the Aorta	-	-	-
Subtotal	**13 (61.9)**	**12 (57.1)**	**13 (61.9)**
Cyanotic Defects			
Tetralogy of Fallot (TOF)	5 (23.8)	5 (23.8)	5 (23.8)
Transposition of the Great Arteries (TGA)	2 (9.5)	2 (9.5)	2 (9.5)
Tricuspid Atresia	1 (4.8)	1 (4.8)	1 (4.8)
Total Anomalous Pulmonary Venous Return	-	1 (4.8)	-
Hypoplastic Left Heart Syndrome (HLHS)	-	-	-
Subtotal	**8 (38.1)**	**9 (42.9)**	**8 (38.1)**
Total	**21 (100)**	**21 (100)**	**21 (100)**

Table No. 3: Comparison of Modified Borg Dyspnea Scale across study groups (baseline pre-exercise, immediate post-exercise and 30 minutes post-exercise)

Borg Score	Balloon Blowing n (%)	Deep Breathing n (%)	Control n (%)	Kruskal–Wallis	p-vale
Baseline Pre-exercise					
0	-	-	1 (4.8)	2.18	0.702
0.5	1 (4.8)	1 (4.8)	2 (9.5)		
1	2 (9.5)	3 (14.3)	5 (23.8)		
2	4 (19.0)	5 (23.8)	6 (28.6)		
3	5 (23.8)	5 (23.8)	4 (19.0)		
4	6 (28.6)	5 (23.8)	2 (9.5)		
5–10	3 (14.3)	2 (9.5)	1 (4.8)		
Immediate Post-exercise					
0	-	-	1 (4.8)	2.18	0.702
0.5	1 (4.8)	1 (4.8)	2 (9.5)		
1	2 (9.5)	3 (14.3)	5 (23.8)		
2	4 (19.0)	5 (23.8)	6 (28.6)		
3	5 (23.8)	5 (23.8)	4 (19.0)		
4	6 (28.6)	5 (23.8)	2 (9.5)		
5–10	3 (14.3)	2 (9.5)	1 (4.8)		
30 Minutes Post-exercise					
0	4 (19.0)	5 (23.8)	1 (4.8)	10.92	0.004
0.5	6 (28.6)	6 (28.6)	2 (9.5)		
1	5 (23.8)	5 (23.8)	5 (23.8)		
2	4 (19.0)	3 (14.3)	6 (28.6)		
3	2 (9.5)	2 (9.5)	4 (19.0)		
4-10	-	-	3 (14.3)		

Table No. 4: Comparison of mean Borg Dyspnea score between intervention groups

Time Point	Balloon Blowing	Deep Breathing	t-value	p-value
T1	1.74±1.1	1.88±1.2	0.41	0.683
T2	3.12±1.4	3.05±1.3	0.18	0.858
T3	1.02±0.9	1.10±0.8	0.32	0.749
T4	0.48±0.6	0.52±0.5	0.27	0.790

Table No. 5: Overall comparative effectiveness summary

Outcome	Superior Group	Difference	p-value
Dyspnea (Borg)	None	Minimal	>0.05

DISCUSSION

The groups were socio-demographically comparable at baseline. Most participants were aged 3-5 years, consistent with Abd al Ameer Hussein and Shawq.[8] Sex distribution was balanced (χ^2=0.19, p=0.909), similar to Salih and Obaid.[9] Comparable pediatric demographic patterns have also been reported by Naeem and Ajil[10], while Mohammed[11] found that most children lived in urban areas. This baseline comparability strengthened the internal validity of the intervention comparisons. The distribution of cyanotic and acyanotic congenital heart defects reflected clinical heterogeneity within the sample. Because disease severity and oxygenation may influence respiratory responses, documenting these diagnoses was important when interpreting intervention effects.

Baseline Modified Borg scores were comparable among the balloon-blowing, deep-breathing, and control groups (χ^2=0.18, p=0.914), indicating similar initial dyspnea severity. Immediately after exercise, Borg scores increased slightly in both intervention groups, but the difference among groups was not significant (χ^2=2.18, p=0.702). Similar transient increases in perceived respiratory effort following respiratory training have been reported by Gharaveis et al[12] and Rao et al.[13] This response may reflect the temporary increase in ventilatory demand during active breathing exercises.

At 30 minutes, a significant difference emerged among the groups (χ^2=10.92, p=0.004). Both intervention groups shifted toward lower dyspnea scores, whereas the control group retained more moderate-to-severe scores. Similar reductions in dyspnea following recovery from structured respiratory exercise were reported by Wisner et al.[14] These improvements may result from enhanced alveolar expansion, ventilation-perfusion matching, respiratory muscle recruitment, and reduced work of breathing.

Balloon blowing and deep breathing produced similar reductions in dyspnea, with no significant differences between the two techniques. Improvement following deep-breathing exercises has also been reported by Hussein and Hattab.[15] Regarding demographic characteristics, nuclear families predominated, consistent with Maryam and Hassan[16], while most mothers were housewives, similar to the findings of Shauq.[17]

The comparable outcomes may reflect shared physiological mechanisms, including improved ventilatory efficiency, lung expansion, respiratory muscle activation, and gas exchange. Balloon blowing may offer greater engagement for younger children because of its play-based nature, whereas conventional deep breathing may be easier to implement in structured clinical settings. Overall, neither technique demonstrated superiority over the other across dyspnea nor other assessed physiological outcomes. These findings support the use of either intervention according to the child's developmental level, preference, clinical condition, and feasibility. The observed benefits appear to relate primarily to respiratory training rather than to a unique effect of either technique.

CONCLUSION

Both balloon-blowing and deep-breathing exercises reduced dyspnea compared with routine care, with no significant difference between the two interventions. Both techniques therefore represent feasible non-pharmacological approaches for respiratory support in children with congenital heart disease.

RECOMMENDATIONS

Balloon-blowing or deep-breathing exercises may be incorporated into routine nursing care for children with congenital heart disease. Selection of either technique can be guided by the child's preference, clinical condition, developmental level, and feasibility.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Marwa Nayef Khassaf Abass, Khatam Mutasher Hattab
Drafting or Revising Critically:	Marwa Nayef Khassaf Abass, Khatam Mutasher Hattab
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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Original Article

Self-Care of Pruritus Among Patients Undergoing Regular Hemodialysis Sessions

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ABSTRACT

Objective: To assess pruritus disorders among patients undergoing hemodialysis
Study Design: Descriptive cross-sectional study
Place and Duration of Study: This study was conducted at the Al-Hilla City Al-Imam Sadeq Teaching Hospital, Iraq, from 1st April 2026 to 30th June 2026.
Methodology: The study described specific phenomena of interest related to self-care knowledge deficit for pruritus disorders among patients undergoing regular hemodialysis sessions.
Results: Overall knowledge level of the participants was predominantly at a moderate level and most items achieved mean scores ranging from 1.50 to 1.63.
Conclusion: There is a huge knowledge deficit in patients' knowledge regarding the nature of skin changes and importance of professional skin care, which may lead to exacerbation of these conditions.
Key Words: Self-care, Hemodialysis, Pruritus.

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INTRODUCTION

Worldwide occurrence and prevalence of dermatologic diseases in dialysis patients Epidemiological studies demonstrate that at least one dermatological disorder develops in more than 70-90% of patients on long term hemodialysis during the course of their illness. Uremic pruritus alone has been reported to affect about 40 to 60% of hemodialysis patients worldwide, with prevalence differing by region, adequacy of dialysis and comorbid conditions. These skin diseases are not just cosmetic, they have been shown in large observational studies and registry-based analyses to be associated with increased sleep disturbance, depressive symptoms and even increased mortality risk among patients with severe pruritus.[1,2]

Skin changes in patients on hemodialysis cause psychological distress as well as physical discomfort. Visible findings such as hyperpigmentation, excoriations from scratching, vascular access scars, etc. can have a negative impact on body image and self-esteem. These changes may increase the feeling of stigma, social withdrawal and loss of personal identity, especially in younger patients and women. Research has shown a significant correlation between dermatological symptoms, depressive disorders, and decreased self- confidence among dialysis populations, emphasizing the link between physical appearance, mental health, and holistic well-being.[3]

Self-care is a critical component of chronic disease management and is especially important for patients on long-term hemodialysis. In ESRD, self-care refers to the patient's capacity to carry out activities to maintain health, manage symptoms, and prevent complications, including skin-related issues. Because of the chronic and demanding nature of hemodialysis, effective self-care practices such as treatment adherence, skin hygiene, and symptom monitoring are critical to minimizing morbidity and enhancing autonomy. It's very similar to Orem's Self-Care Deficit Nursing Theory which stresses supporting the patient to meet their self-care needs when illness limits independence.[4,5]

Participation in self-care activities has positive effects on physical and psychological outcomes in hemodialysis patients. Self-care management of skin symptoms is effective in reducing the intensity of

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pruritus and improving sleep quality and health related quality of life.[6]

METHODOLOGY

This descriptive cross-sectional study was conducted at Al-Hilla City Al-Imam Sadeq Teaching Hospital, Iraq from 1st April 2026 to 30th June 2026. A non - probability convenience sample method was selected to assign the participants who regular undergoing hemodialysis sessions. A total of 160 patients were selected to participate in the study out (165) of the patient's. patients who are scheduled for regular hemodialysis sessions. Ten of the participants were assigned to the pilot study and were subsequently excluded from the original study sample (150). The sample size has been determined by using Richard Geiger's equation. To achieve the study objectives, a specific questionnaire was prepared after an extensive review of related literature adopted by Mettang & Kremer.[7] Part I consist of the demographical characteristics of the study sample includes age, sex, educational level, marital status, occupation and residency). Part II include clinical information related to (duration on hemodialysis, frequency of hemodialysis session per week). Part III includes knowledge and Self-care of pruritus disorders. The part consists of multiple-choice questions distributed among three domains to assess the knowledge deficit related to self-care for cutaneous disorders among patients undergoing regular hemodialysis sessions. Distributed as the section consists of 27 items to assesses knowledge and self-care related to pruritus (itching). The data was analyzed through SPSS-26.

RESULTS

Table No. 1: Demographic information of the patients

Variable	No.	%
Age (years)		
<30	28	18.7
30-49	52	34.7
≥50	70	46.6
Gender		
Male	88	58.7
Female	62	41.3
Residency		
Urban	96	64.0
Rural	54	36.0
Educational state		
Illiterate	30	20.0
Read & Write	22	14.7
Primary	28	18.7
Secondary	35	23.3
College+	35	23.3
Occupation		
Working	57	38.0
Not working	93	62.0

Nearly half of the study samples (46.6%) were 50 years and above, 34.7% were within the age range of 30-49 years and only 18.7% were below 30 years (Table 1). Nearly half of the subjects in the study (45.3%) had undergone hemodialysis for 1-5 years, 33.3% had received dialysis for 6-10 years, and 21.4% had undergone dialysis for more than 10 years (Table 2). Pruritus is highly common among patients who are on regular hemodialysis sessions, 73.3% of the study sample reported presence of itching. The distribution of knowledge responses of the study sample on self-care deficit for pruritus among patients undergoing regular hemodialysis sessions were shown in Tables 3-5.

Table No. 2: Distributions of study samples related to their clinical data

Variable	No.	%
Duration of hemodialysis (Years)		
1–5	68	45.3
6–10	50	33.3
>10	32	21.4
Dialysis sessions/Week		
Twice	42	28.0
Three times	108	72.0

Table No. 3: Distributions of study sample responses regarding pruritus (assessment of itching)

Variable	No.	%
Presence of itchsing		
Yes	110	73.3
No	40	26.7
Severity		
Mild	55	36.7
Moderate–Severe	95	63.3
Location		
Whole body	80	53.3
Localized areas	70	46.7
Sleep disturbance		
Yes	90	60.0
No	60	40.0
Day comfort affected		
Mild	58	38.7
Moderate–Severe	92	61.3
Skin injury due to scratching		
Yes	88	58.7
No	62	41.3
Common sign		
Scratch marks	100	66.7
No visible signs	50	33.3
Severe pruritus sign		
Scarring	85	56.7
Other signs	65	43.3
Relation to dialysis		
Before session	98	65.3
After/Not related	52	34.7
Home environment		
Dry air	105	70.0
Humid/variable	45	30.0
Clothing type		
Synthetic/Wool	94	62.7
Cotton	56	37.3

Table No. 4: Distribution of study sample responses regarding pruritus (general information)

Item	Correct		Incorrect		Mean±SD	Level
	No.	%	No.	%		
Skin barrier	95	63.3	55	36.7	1.63±0.48	Fair
Causes of skin changes	30	20.0	120	80.0	1.20±0.49	Poor
Causes of pruritus	85	56.7	65	43.3	1.57±0.50	Fair
Complications of pruritus	80	53.3	70	46.7	1.53±0.50	fair
Management of pruritus	92	61.3	58	38.7	1.61±0.49	Fair
Daily bathing effect	78	52.0	72	48.0	1.52±0.50	Fair
Bathing frequency	82	54.7	68	45.3	1.55±0.50	Fair
Soap size	75	50.0	75	50.0	1.50±0.50	Fair
Soap type	88	58.7	62	41.3	1.59±0.49	Fair
Skin pH	84	56.0	66	44.0	1.56±0.50	Fair
Overall Knowledge	889	59.3	1500	40.7	1.53±0.50	Fair

Table No. 5: distribution of study sample knowledge responses regarding pruritus (self care)

Item	Correct		Incorrect		Mean±SD	Level
	No.	%	No.	%		
Moisturizing frequency	85	56.7	65	43.3	1.57±0.50	Fair
Type of moisturizer	90	60.0	60	40.0	1.60±0.49	Fair
Time of application	88	58.7	62	41.3	1.59±0.49	Fair
Soap type	92	61.3	58	38.7	1.61±0.49	Fair
Water temperature	35	23.3	115	76.7	1.23±0.48	Poor
Drying method	89	59.3	61	40.7	1.59±0.49	Fair
Total	489	54.3	411	45.7	1.54±0.20	Fair

DISCUSSION

In the present study, 46.6% was 50 years and above, 34.7% were within the age range of 30-49 years and only 18.7% were below 30 years. This finding shows that regular hemodialysis is more common in the elderly due to the progressive course of chronic kidney disease and its comorbidities such as hypertension and diabetes mellitus. Daraghmeh et al[8] reported that the mean age of hemodialysis patients was around 55 years and that a large proportion of participants were elderly. This study showed that 58.7% were males while 41.3% were females. This may be related to a higher prevalence of chronic renal failure in men and greater exposure to risk factors for renal impairment. This finding is consistent with Daraghmeh et al[8] reported 62.8% of their participants were male while Tameezuddin et al[9] also reported a predominance of male patients on dialysis. This study also showed that 64.0% of the participants were from urban areas while 36.0% were from rural areas. This finding may be related to the availability of dialysis centers and health care services in urban areas, which allows regular attendance for hemodialysis sessions and follow-up care. Living in urban areas may also be conducive to health education and self-care information regarding cutaneous disorders.

This study showed 23.3% had secondary education and 23.3% had college level or above. However, 20% were illiterate and 14.7% could read and write only. The low educational level may negatively affect the patients' understanding of the self-care instructions and adherence to the preventive measures to skin complications such as xerosis and pruritus. This finding is in line with Nia et al[10] which reported the educational level of most hemodialysis patients below high school, which influenced self-care behaviors and body image concerns.

Majority of the participants were not working (62%) and only 38% were engaged in an occupation. This may be due to the physical burden of chronic kidney disease, frequent dialysis, fatigue, and associated cutaneous symptoms, all of which limit patients' ability to hold employment. Similar results were also reported by Daraghmeh et al.[8]

In current study, majority of patients (72%) were also on thrice weekly hemodialysis, while 28% were on twice weekly dialysis sessions (Table 2). These results suggest that most of the participants were undergoing regular and intensive dialysis treatment, which may make them susceptible to skin disorders, such as xerosis, pruritus, skin dryness and irritation, due to prolonged exposure to physiological changes related to dialysis. The findings are consistent with Radwan et al[11], which reported that patients who had longer durations of hemodialysis experienced higher levels of pruritus and skin-related complications. They found a significant association between years of dialysis treatment and increased severity of itching among hemodialysis patients. Similarly, Sukul et al[12] demonstrated that chronic kidney disease-associated pruritus is highly prevalent among patients receiving maintenance hemodialysis, especially among those undergoing long-term and frequent dialysis sessions.

The findings of this study indicate that the overall knowledge level of the participants was predominantly at a moderate level. Most items achieved mean scores ranging from 1.50 to 1.63, which fall within the moderate category according to the study scoring system (1.34-1.67). Only one item, related to the causes of skin changes (Q2), showed a mild level of knowledge with a mean score of 1.20, indicating insufficient understanding among patients regarding dermatological alterations associated with chronic kidney disease and hemodialysis. The highest correct response was found in Q1 on the skin barrier (63.3%) followed by Q5 related to the management of pruritus (61.3%). The lowest correct response was related to causes of skin changes (20.0%). The results suggest that patients have basic knowledge of pruritus symptoms and management, but limited knowledge of the physiological and pathological mechanisms of skin disorders. Moreover, about half of the participants answered correctly the questions related to the frequency of bathing, type of soap, size of soap, and skin pH, which shows a moderate understanding of self-care practices needed to reduce skin irritation and dryness among hemodialysis patients. These findings are consistent with Al-Khafaji and Al-Mayahi[13] which reported that hemodialysis patients demonstrated moderate knowledge concerning uremic pruritus, particularly regarding symptom recognition and daily skin care measures, while deficiencies were identified in understanding the causes and complications of pruritus.

A recent systematic review by Turgay et al[14] emphasized that chronic kidney disease-associated pruritus significantly affects patients' quality of life, sleep quality, and psychological well-being, and highlighted the importance of patient education and self-care interventions in improving outcomes among hemodialysis patients. The current findings support this evidence, as patients demonstrated relatively better knowledge regarding management strategies compared with theoretical understanding of disease mechanisms.

The xerosis, inflammation, and skin barrier dysfunction are major contributors to chronic kidney disease-associated pruritus. A systematic review by Cîrstea et al[15] highlighted the importance of regular skin moisturization, avoidance of irritating soaps, and adherence to self-care recommendations for reducing itching severity and improving patient comfort.

In the present study, 73.3% have presence of itching. These findings suggest that pruritus is still one of the most frequent dermatologic complications in patients on hemodialysis and negatively influences patients' comfort, sleep and quality of life. Additionally, 63.3% of the participants experienced moderate-to-severe itching suggesting poor control of symptoms and inadequate skin management self-care practices. In the current study, 53.3% of patients experienced generalized itching over the whole body while 46.7% reported localized itching. These findings are consistent with recent evidence that chronic kidney disease-related pruritus often presents with generalized pruritus, mainly due to metabolic disturbances, inflammatory mediators, xerosis and toxin accumulation among patients on hemodialysis. Sixty percent of patients reported that pruritus disrupted sleep, and 61.3% reported moderate to severe interference with daytime comfort. These findings are in line with the study by Shetty et al[16] which showed that uremic pruritus has a significant impact on sleep quality and health-related quality of life in patients undergoing hemodialysis. Sukul et al[12] also reported that persistent pruritus in patients undergoing hemodialysis was strongly associated with poor patient-reported outcomes, sleep disorders, psychological distress, and poor quality of life.

The present study also found that skin lesions due to scratching were seen in 58.7% of patients and visible scratch marks were seen in 66.7% of patients. This may be because of poor compliance to self care measures including regular skin hydration, nail care, avoidance of excessive scratching and appropriate skin protection. Xerosis and poor topical skin care have been highlighted in recent reviews as important in skin damage and worsening pruritus in patients on dialysis. 56.7% of the participants had scars due to severe pruritus. This is suggestive of chronicity of itching and recurrent trauma to the skin due to constant scratching. The findings are in keeping with previous literature that chronic pruritus can cause excoriations, secondary skin lesions and increased susceptibility to infection in patients on long term hemodialysis. Also present in the present study were environmental and lifestyle factors. About 70.0% of patients were in dry-air environments and 62.7% wore synthetic or wool clothing, which are known to exacerbate skin dryness and pruritus. The current results are consistent with the recommendations of recent studies which have highlighted the significance of self-care practices including skin moisturization, avoidance of irritant fabrics and improvement of environmental humidity to alleviate cutaneous symptoms among hemodialysis patients.

This study showed that most of the participants had a moderate level of knowledge and practice regarding skin care measures for pruritus management. Highest correct responses were soap type (61.3%), type of moisturizer (60.0%), method of drying (59.3%), time of application (58.7%), and frequency of moisturizing (56.7%). The mean scores of these items ranged from 1.57 to 1.61, indicating a moderate level of self-care awareness. In contrast, water temperature had the lowest percentage of correct responses (23.3%) with an average score of 1.23, indicating a mild level of knowledge. This finding shows that a large number of hemodialysis patients may not be aware of the importance of avoiding hot water, which may aggravate skin dryness and aggravate pruritus symptoms. These results are in line with the review by Krismi et al[17]. (2023) which highlighted xerosis as one of the most common dermatological manifestations in patients

undergoing hemodialysis and its strong association with the severity of chronic kidney disease-related pruritus. Their study emphasized the role of topical therapy, moisturizers, mild soaps and adequate skin hydration in reducing the intensity of itch and improving the quality of life among dialysis patients.

CONCLUSION

Skin manifestations are very common in hemodialysis patients with uremic pruritus (itching) being the most dominant symptom affecting the majority of the sample. There is a huge knowledge deficit in patients' knowledge regarding the nature of skin changes and importance of professional skin care, which may lead to exacerbation of these conditions

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Original Article

Acute Capillary Glucose Responses to Sweetened Beverages, Spice Infusions, and Mineral-Rich Water in Healthy Young Adults: A Randomized Parallel-Group Study

Hassan Almarshad

ABSTRACT

Objective: To compare the acute capillary glucose responses to sweetened beverages, unsweetened cinnamon and ginger infusions, mineral-rich Zamzam water, and plain bottled water in healthy young adults after an overnight fast

Study Design: Randomized, controlled, parallel-group study

Place and Duration of Study: This study was conducted at the Jouf University, Sakaka, Saudi Arabia, from 1st February 2020 to April 2023.

Methodology: A total of 144 healthy university students aged 19-25 years were assigned equally to receive 250 mL of orange juice, a honey drink, a ginger infusion, a cinnamon infusion, Zamzam water, or plain bottled water after an overnight fast.

Results: Capillary glucose was measured before and 60 min after consumption, with 24 participants in each group. Mean glucose increased most after honey (+20.09 mg/dL) and orange juice (+17.33 mg/dL). Changes after cinnamon (-3.58 mg/dL), ginger (-3.91 mg/dL), and plain water (-2.84 mg/dL) were small. Zamzam water showed a modest increase (+9.83 mg/dL). Overall change differed among groups ($p<0.0001$).

Conclusion: The spice-infusion do not establish glucose-lowering effects, and the Zamzam result cannot establish a mineral-mediated mechanism.

Key Words: Blood Glucose, Beverage Intervention, Honey, Orange Juice, Cinnamon, Ginger, Mineral-Rich Water.

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INTRODUCTION

Type 2 diabetes and related metabolic disorders continue to impose a substantial global health burden.[1] Dietary carbohydrate quality and quantity influence glycemic exposure, and beverages are particularly relevant because liquid sugars can be consumed rapidly and provide limited satiety. Habitual intake of sugar-sweetened beverages has been associated with weight gain and cardiometabolic risk,[2] while fruit juice has also been associated with incident type 2 diabetes in prospective evidence.[3]

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Acute glucose excursions are therefore relevant when comparing beverages, although a single post-consumption value should not be equated with a diagnostic glucose-tolerance test or long-term glycemic variability.[4]

Cinnamon and ginger are commonly used in traditional and functional beverages. Experimental work suggests that cinnamon-derived compounds may influence insulin signaling and carbohydrate-digesting enzymes,[5] and trials in people with type 2 diabetes have reported modest improvements in selected glycemic outcomes after sustained cinnamon supplementation.[6] Gingerols may promote glucose uptake in experimental models,[7] and longer-term ginger supplementation has been studied in people with diabetes.[8,9] These findings do not establish that a single serving of an unsweetened spice infusion lowers glucose in healthy fasting adults. In the absence of a carbohydrate challenge, a neutral response may simply reflect the lack of digestible sugar.

Mineral composition may also influence metabolic physiology, but evidence that drinking water acutely alters glucose regulation is limited.[10] Zamzam water is naturally mineral-rich groundwater obtained from the Zamzam well in Makkah, Saudi Arabia. Published

analyses report variable composition according to source and analytical method.[11,12] Any acute difference therefore requires direct compositional measurement and an appropriate mineral-matched comparator before it can be attributed to total dissolved solids (TDS) or to an individual mineral.

The purpose of this study is to compared the acute capillary glucose response to two carbohydrate-containing beverages (honey drink and orange juice), two unsweetened spice infusions (cinnamon and ginger), mineral-rich Zamzam water, and plain bottled water after an overnight fast. We expected the carbohydrate-containing beverages to produce the largest increases, while the responses to the unsweetened beverages would be smaller. The comparison involving Zamzam water and the assessment of unintended events were exploratory objectives.

METHODOLOGY

This randomized, controlled, parallel-group, exploratory intervention study recruited 144 healthy university students at Jouf University, Saudi Arabia, from 1st February 2020 to 30th April 2023 letter No. JU-LCBE-8-18-9-40 dated 23/05/2019. All participants provided written informed consent before study procedures, and the study was conducted in accordance with the Declaration of Helsinki. Participants were recruited through campus advertisements and screened before written consent. Inclusion criteria were current enrollment at Jouf University, age 19-25 years, self-reported good health, ability to complete the required overnight fast, and willingness to consume any of the six study beverages. Exclusion criteria were diabetes or impaired glucose regulation; chronic endocrine, metabolic, renal, hepatic, or gastrointestinal disease; acute illness at the study visit; use of medication or supplements known to affect glucose metabolism; or allergy or intolerance to any study-beverage ingredient.

After an overnight fast and baseline glucose measurement, participants consumed the assigned 250 mL beverage under staff observation. Orange juice was a commercial 250 mL KDD pack (The Kuwaiti Danish Dairy Co. K.S.C.C, Kuwait; FJUQL6ORNGRP),[13] with 50 g sugar reported by the source record but not analytically verified. The honey drink contained approximately 50 g Black Forest honey in 250 mL water; the ginger infusion approximately 12 g fresh ginger in 250 mL water (48 g/L); and the cinnamon infusion 2.6 g cinnamon in 250 mL water (10.4 g/L). Zamzam water was a 250 mL commercially bottled product with label-reported TDS below 600 mg/L; the comparator was 250 mL Nova water with label-reported TDS of 120 mg/L. The waters were not chemically analyzed and product-lot information was unavailable.

Capillary whole-blood glucose was measured using six Contour glucometers and compatible test strips. Quality-control checks were performed with Contour control solution according to the manufacturer's procedure; the recorded test-strip lot was 2020. Standard hand preparation, lancing, and medical-waste procedures were followed. Three replicate readings were obtained at each time point and averaged. Measurements were taken immediately before beverage consumption and 60 min afterward. This assessment was not considered an oral glucose tolerance test because a standardized oral glucose load was not administered.

The primary outcome was the within-participant change in capillary glucose, calculated as the mean 60-min post-consumption glucose minus the mean fasting baseline glucose (Delta glucose, mg/dL). The 60-min post-consumption glucose value was the secondary outcome. No diagnostic classification was assigned to post-consumption values because a single capillary measurement after a non-standardized beverage challenge is not a diagnostic test.

Potential harms included symptoms or events related to fasting, beverage consumption, or finger-prick testing, including dizziness, nausea, allergy or intolerance, pain, bleeding, or bruising. Participants were observed during the session and asked about symptoms at 60 min. The anticipated physical risk was minimal, and no extended harms follow-up was planned.

Analyses used GraphPad software (San Diego, CA, USA). Within-group baseline and 60-min values were compared by paired t-test, and one-way analysis of variance compared change scores among groups. The original record referred to Tukey multiplicity adjustment, but complete diagnostic output, the exact F statistic, and adjusted pairwise estimates were not retained. Tests were two-sided, with $p < 0.05$ considered significant.

RESULTS

Overall, 144 received the assigned intervention, completed the 60-min assessment, and were included in the per-protocol primary analysis (24 per group). Mean fasting capillary glucose ranged from 79.17 mg/dL in the Zamzam-water group to 91.33 mg/dL in the cinnamon-infusion group (Table 1).

The two carbohydrate-containing beverages produced the largest mean increases: +20.09 mg/dL after the honey drink and +17.33 mg/dL after orange juice. Mean changes after cinnamon infusion (−3.58 mg/dL), ginger infusion (−3.91 mg/dL), and plain bottled water (−2.84 mg/dL) were small. The Zamzam-water group showed a mean increase of +9.83 mg/dL. The reported one-way analysis of variance indicated that mean change differed among the six groups ($p < 0.0001$). The confidence intervals and paired-test results for all groups are shown with corresponding 95% confidence intervals (Figure 1).

Table No. 1: Capillary glucose before and after beverage consumption in the analyzed sample (n = 24 per group)

Beverage	Baseline, mg/dL	Post, mg/dL	Mean change	95% CI of change	Paired p value
Honey drink	89.83±7.20	109.92±9.79	+20.09	+15.50 to +24.68	<0.0001
Orange juice	86.50±9.42	103.83±17.26	+17.33	+6.10 to +28.56	0.0058
Zamzam water	79.17±6.09	89.00±5.17	+9.83	+5.20 to +14.46	0.0003
Plain water	88.42±10.45	85.58±8.69	-2.84	-11.18 to +5.50	0.48
Cinnamon infusion	91.33± 6.88	87.75±6.89	-3.58	-9.62 to +2.46	0.22
Ginger infusion	88.73±9.73	84.82±8.53	-3.91	-12.22 to +4.40	0.33

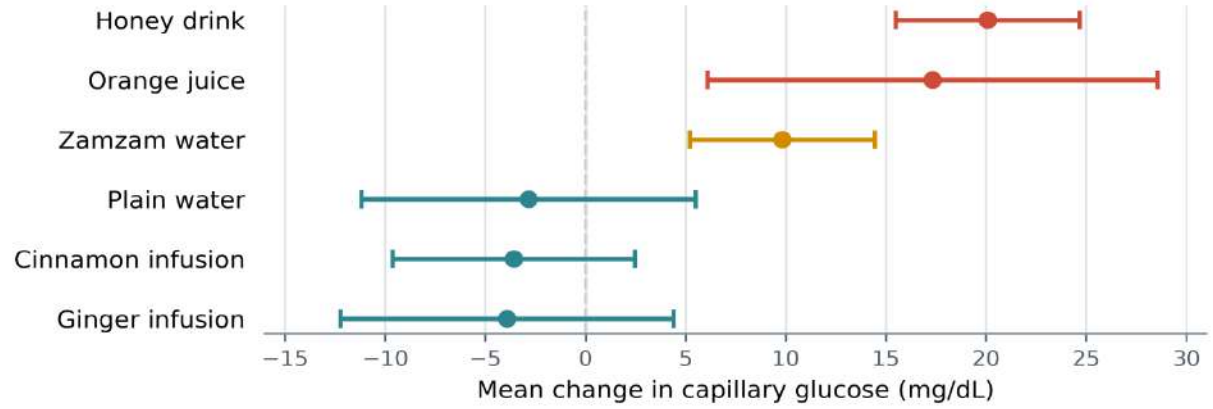


Figure No. 1: Mean within-group change in capillary glucose after beverage consumption. Positive values indicate an increase from fasting baseline

DISCUSSION

In healthy young adults studied after an overnight fast, the carbohydrate-containing beverages produced the largest acute increases in capillary glucose. Plain bottled water and the unsweetened cinnamon and ginger infusions showed little mean change. Mineral-rich Zamzam water showed a modest within-group increase, but the parallel-group design and available analysis do not establish a mineral-mediated mechanism. The responses to the honey drink and orange juice are biologically plausible because both supplied rapidly available carbohydrate. This acute experiment is consistent with broader evidence linking sugar-containing beverages with adverse glycemic and cardiometabolic outcomes.[2,3] However, post-consumption values should not be described as prediabetic or pathological: diagnostic thresholds for fasting glucose or standardized oral glucose tolerance testing do not apply to a single capillary measurement after non-standardized beverages.

The neutral responses to cinnamon and ginger require conservative interpretation. The standardized extracts or supplements over weeks or months in people with diabetes.[14,15] In this study, the infusions were unsweetened and contained fresh ginger at approximately 48 g/L or cinnamon at 10.4 g/L; no carbohydrate challenge was co-administered. The results therefore show that these drinks did not acutely increase mean glucose. They do not demonstrate active glucose lowering, enhanced insulin sensitivity, inhibition of carbohydrate digestion, or prevention of a glycemic spike.

The Zamzam-water observation is hypothesis-generating. Approximately 18.5-42 mg/L magnesium, 56.5-93 mg/L calcium, and 67.1-210 mg/L sodium, with values varying by sampling source and analytical method.[11,12] Magnesium participates in insulin signaling and glucose transport, while calcium contributes to pancreatic beta-cell insulin secretion. Biological variation in capillary glucose also warrants consideration when interpreting a modest change from a single baseline measurement.[16] Nevertheless, the administered water was not analyzed, and insulin and circulating mineral concentrations were not measured and baseline imbalance and regression to the mean also remain plausible explanations. The present study therefore cannot attribute the observed change to magnesium, calcium, sodium, TDS, or another mineral pathway.

Acute human trials show that beverage composition, comparator selection, and sampling schedule influence observed glycemia. Glycemic responses differed among honey varieties even when available carbohydrate was standardized.[17] Orange-pomace fiber attenuated the acute glycemic response to sugar-matched orange juice.[18] Cinnamon consumed with a carbohydrate meal reduced postprandial glucose and delayed gastric emptying in a small crossover trial,[19] while a standardized ginger aqueous extract was evaluated

using repeated postprandial measurements in nondiabetic adults.[20,21] These protocols illustrate why exact ingredient dose, beverage composition, comparator selection, and multiple sampling times should be documented.

Several limitations materially affect interpretation. First, demographic and clinical characteristics by group, a formal a priori power calculation, detailed pretest dietary and activity standardization, complete adherence reasons, and systematic group-specific harms data were not retained. The trial was not prospectively registered, and no publicly accessible protocol or statistical analysis plan is available. Second, although ingredient concentrations were documented, the botanical species, full infusion conditions, product lots, and nutritional and mineral composition of the administered beverages were not analytically verified. Third, capillary glucose was measured at only one post-consumption time point; the study cannot characterize peak response, incremental area under the curve, glycemic variability, or insulin dynamics. Glucose-meter user technique and strip-lot variability can affect measurements, although quality-control checks and triplicate readings were used. Fourth, the exact ANOVA statistics, complete assumption diagnostics, updated precision estimates for two groups, and multiplicity-adjusted pairwise comparisons were unavailable. Finally, exclusion of 36 randomized participants from the per-protocol analysis may introduce attrition bias, and the healthy student sample limits generalizability to older adults and people with impaired glucose regulation.

CONCLUSION

After an overnight fast, the honey drink and orange juice produced the largest acute increases in capillary glucose. The small changes after unsweetened cinnamon and ginger infusions are compatible with their lack of added sugar but do not establish an antihyperglycemic effect. The modest within-group rise after Zamzam water is hypothesis-generating and cannot be attributed to mineral content because the administered water and relevant circulating biomarkers were not analyzed. Future trials should directly characterize beverages, use a crossover or baseline-adjusted design, obtain venous glucose and insulin at multiple time points, and prespecify analyses in a registered protocol.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Hassan Almarshad
Drafting or Revising Critically:	Hassan Almarshad
Final Approval of version:	The above author
Agreement to accountable for all aspects of work:	The above author

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Original Article

Hemovigilance and Red Cell Phenotyping among Patients with Hereditary Blood Diseases in Basra, Southern Iraq

Basim A. Al-Hijaj[1], Ali K. Jumaa[2], Zaynab R. Qasim[3] and Qutaiba M. Dawood[4]

ABSTRACT

Objective: To assess the incidence of direct antiglobulin test positivity and to profile severity and demographic parameters of acute transfusion reactions

Study Design: Cross sectional descriptive study

Place and Duration of Study: This study was conducted at the Basra Centre for Hereditary Blood Diseases, Basra Southern Iraq, from 15th September 2025 to 15th February 2026.

Methodology: 1426 patients were registered. The blood bank electronic real-time database under the supervision of qualified blood bank laboratory technicians was used to obtain the data. The transfusion events monitored were 108 and analysed were ABO/Rh(D) typing, extended Rh phenotyping (D, C, c, E, e antigens), direct antiglobulin test and hemovigilance data.

Results: There were 38.43% of peoples have blood group O+ and Rh(D)-positive rate was 92.78%. The most frequent extended Rh phenotype was the R1r (31.41%). The overall percentage of direct antiglobulin test positivity was 40% and was the highest in β-thalassaemia major (55.6%). Grade B (moderate) transfusion reactions were the most common (67.6%), and 69.5% of the reactions were Grade A (mild) or B (moderate).

Conclusion: The transfusion-dependent population extended Rh phenotyping and systematic hemovigilance is necessary. The high DAT positivity and moderate to severe reaction rates highlight the need for antigen matched blood strategies and formal hemovigilance systems.

Key Words: Hemovigilance, Red blood cell, Phenotyping, Rh antigens; Direct antiglobulin test, Transfusion reactions.

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INTRODUCTION

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Blood transfusion continues to play a critical role in the management of most of the hereditary blood disorders, such as β-thalassemia major (β-TM), sickle cell disease (SCD). Although the introduction of transfusion therapy has had a positive impact on the survival and quality of life of those who suffer from it, repeated exposure to donor red blood cells has been associated with certain immunological complications including alloimmunization, autoimmunization, and transfusion-related adverse reactions (TRA).[1,2] Such complications can lead to increased transfusion needs, may make the determination of compatibility more difficult and can be a source of morbidity in chronically transfused patients.

ABO and Rhesus (Rh) blood group systems are the two most clinically important antigen systems in transfusion medicine. Compatibility testing of ABO and Rh(D) blood group types is regular before transfusion but incompatibilities with minor Rh antigens like C, c, E and e are still significant causes of alloantibody formation in transfusion-dependent patients.[3]

Extended red cell phenotyping is therefore becoming an important tool for decreasing alloimmunization and improving transfusion safety, particularly in patients that have a need for transfusion on a life-long basis.[4]

Hemoglobin disorders are a significant burden in the public health sector in Iraq. Southern Iraq, including Basra Province, has high prevalence of β-thalassemia major, sickle cell disease and related hemoglobinopathies, partly due to the high prevalence of consanguineous marriages.[5] Epidemiologic studies carried out recently in Basra have identified an increasing number of patients who need to receive regular transfusion therapy and long-term hematological care.[6] In addition, research conducted in Basra has shown the clinical use of Rh and Kell antigen typing to improve transfusion support for this high-risk population.[7]

ABO and Rh blood groups are distributed differently in various ethnic groups and populations. However, several studies in Iraq have indicated that the major ABO blood group phenotype is O and the major Rh(D) blood group phenotype is Rh(D)+ (over 90%).[8,9] One of the major complications of repeated transfusion therapy is red cell alloimmunization. Alloantibodies are produced when a person is exposed to foreign erythrocytes, most often Rh and Kell antigens. These antibodies can cause delayed hemolytic transfusion reactions, problems obtaining blood that matches patients, and higher health cost.[10,11] In the past, Rh and Kell antigens have been found as the main antigens involved in alloimmunisation in multi-transfused patients in Iraq[12,13] and this is the reason for the necessity of developing better compatibility methods. The Direct Antiglobulin Test (DAT) is a commonly employed technique to identify the presence of in vivo sensitization of red blood cells with immunoglobulin or complement components. DAT positivity has been described on a regular basis in multi-transfused patients who have thalassemia and sickle cell disease and could be a result of the presence of alloantibodies, autoantibodies or continued immune mediated hemolysis.[14,15] Therefore, monitoring of DAT status could be useful in understanding the immunologic effects of chronic transfusion therapy. Hemovigilance is becoming an integral part of today's transfusion medicine. It is described as the systematic reporting and monitoring of adverse events throughout the transfusion chain, from blood collection to follow up with recipients.[16] Hemovigilance programs worldwide have shown that the most frequent adverse events associated with blood transfusion are febrile non-hemolytic and allergic reactions.[17,18] Good hemovigilance systems enhance patient safety, support quality assurance and reachable evidence to promote transfusion optimization. Although the incidence of hereditary blood disorders has been rising in Basra, detailed examination of blood group distribution and extended Rh phenotypes, DAT positivity, and blood transfusion adverse events are still limited. The purpose was to find ABO and Rh blood group distribution, characterize extended Rh phenotypes, evaluate the positive DAT and evaluate hemovigilance outcomes among patients of hereditary blood diseases.

METHODOLOGY

This retrospective cross sectional study was carried out at Basra Centre for Hereditary Blood Diseases (BCHBD), Basra Southern Iraq from 15th September 2025 to 15th February 2026 vide letter No. 456778/Approval/DFTBV dated 2nd April 2024. The BCHBD electronic blood bank database, a real-time information system that records patient demographic, clinical diagnosis, transfusion history, blood group phenotypes, serological investigations and adverse events related to transfusion were used to obtain the data. Qualified blood bank laboratory staffs routinely perform data entry verification to insure completeness and accuracy of data. Overall, 1,426 patients were confirmed to have a hereditary blood disorder and were registered. Diagnoses included β-thalassemia major (β-TM), thalassemia intermedia (β-TI), sickle cell disease (HbSS), HbS/β-thalassemia, pure red cell aplasia, aplastic anemia and coagulation factor deficiency. Patients were included if all of their ABO/Rh(D) typing and Rh phenotyping data were stored in the database. Specific analyses were performed excluding records with incomplete serological data.

Standard tube agglutination and gel-card methods were used to detect ABO and Rh(D) blood grouping, using commercially available antisera. Extended Rh phenotyping involved the identification of the 5 main Rh antigens, D, C, c, E and e. The Fisher–Race nomenclature system was used to classify the Rh phenotype combinations. The Direct Antiglobulin Test (DAT) was only ordered when patients had clinical features such as history of hemolysis, transfusion reactions, or physician request to undergo an immunohematologic work up. Anti-human globulin (AHG) method was used for testing. A positive result was defined as any agglutination that was seen.

Patients' clinical staff recorded transfusion reactions, and these were entered into an electronic database, prospectively, during and after transfusion episodes. The hemovigilance analysis included a total of 108 transfusion episodes. Adverse reactions were graded as follows: Grade A: Serious reaction that needs prompt action, Grade B: Moderate reaction that may be treated clinically, Grade C: Mild reaction which requires little intervention to resolve and Grade D: No RATE. The data was analyzed through SPSS-25.

RESULTS

The most common phenotype was blood group O+ (38.43%) followed by blood group A+ and B+ (both 24.54%). The population was predominately Rh-positive with 93.3% of the patients having the Rh(D) positive phenotype and 6.7% having the Rh(D) negative

phenotype (Table 1). The major Rh-antigens revealed high prevalence for e (94.44%), D (92.78%), C (70.80%) and c (70.53%), while E antigen showed the lowest prevalence (22.49%).The results are useful in planning strategies of antigen matching for chronically transfused patients (Table 2).

Extended phenotypic analysis revealed that the most frequent Rh phenotype was R1r (31.41%) followed by R1R1 (25.85%).These had more than 50% of patients. The other phenotypes were less common: R1R2, R2r, R2R2 and rr (Table 3). The clinical indications for DAT were immunological transfusion complications, and it was performed in 35 patients. Overall, 14 (40%) patients were DAT-positive. Patients with β-thalassemia major showed the highest positivity rate while patients with thalassemia intermedia showed the next highest positivity rate (37.5%). Lower positivity rates were observed in sickle cell disease patient (Table 4).

All 108 monitored transfusion episodes were used for hemovigilance analysis. The majority of episodes were in children and adolescents (ages 5–14).The most common reaction category for all age groups was moderate transfusion reactions (Grade B) and severe transfusion reactions (Grade A) occurred in only a few patients (Table 5).

Transfusions for thalassemia patients were the most common monitored transfusion events (78.7%).Moderate transfusion reactions were the most common adverse events reported for all disease categories. The incidence of severe reactions was low and was rarely seen in highly transfusion dependent patients. The numbers of patients with sickle cell disease, aplastic anaemia and other hereditary disorders were fewer as contributors to transfusion episode (Table 6).

Moderate reactions were the most common adverse events reported; mild reactions were present in a smaller number of the monitored transfusion episodes (108). Severe reactions were rare, suggesting that the majority of transfusion-related problems were clinically controllable. However, the number of transfusion reactions observed underlines the need for ongoing hemovigilance monitoring and measures to improve transfusion safety in people with hereditary blood diseases.

Table No. 1: ABO and Rh(D) blood group distribution

Blood Group	ABO Phenotype	Rh(D) Status	No.	%	Rh(D) Sub-total
O+	Group O	Rh(D)+	548	38.43%	1,331 (93.3%)
O-	Group O	Rh(D)−	41	2.88%	95 (6.7%)
A+	Group A	Rh(D)+	350	24.54%	1,331 (93.3%)
A-	Group A	Rh(D)−	15	1.05%	95 (6.7%)
B+	Group B	Rh(D)+	350	24.54%	1,331 (93.3%)
B-	Group B	Rh(D)−	30	2.10%	95 (6.7%)
AB+	Group AB	Rh(D)+	83	5.82%	1,331 (93.3%)
AB-	Group AB	Rh(D)−	9	0.63%	95 (6.7%)

Table No. 2: Blood group antigen frequency (Frequencies are listed by the order of the extended blood group system)

Rh Antigen	Antigen Symbol	Tested (n)	Antigen-Positive	Antigen-Negative
D	RH1	1426	1323 (92.78%)	103 (7.22%)
C	RH2	1421	1006 (70.80%)	415 (29.20%)
c	RH4	1422	1003 (70.53%)	419 (29.47%)
E	RH3	1423	320 (22.49%)	1103 (77.51%)
e	RH5	1422	1343 (94.44%)	79 (5.56%)

Table No. 3: Most prevalent Rh blood group phenotype combinations

Rank	DCcEe Phenotype	Common Nomenclature	No.	%
1	D+ C+ c+ E− e+	R1r (DCe/dce)	446	31.41
2	D+ C+ c− E− e+	R1R1 (DCe/DCe)	367	25.85
3	D+ C+ c+ E+ e+	R1R2 (DCe/DcE)	155	10.92
4	D+ C− c+ E− e+	R2r (DcE/dce) / R0r	145	10.21
5	D+ C− c+ E+ e+	R2R2 (DcE/DcE)	95	6.69
6	D− C− c+ E− e+	rr (dce/dce)	84	5.92
7	D+ C− c+ E+ e−	R2R2 (DcE/DcE) homozygous	46	3.24
8	D+ C− c− E− e+	Other combination	24	1.69
9	D+ C+ c− E+ e+	R1r″ (DCe/DCE)	9	0.63
10	D+ C− c+ E− e−	R0r (Dce/dce)	9	0.63

Table No. 4: The direct antiglobulin test performed as part of the haematological diagnosis

Diagnosis	No. (Total)	DAT Positive	% Positive	DAT Negative	Clinical Implication
β-Thalassaemia Major (β-TM)	18	10	55.6%	8	High DAT positivity reflects alloimmunisation from chronic polytransfusion; warrants extended matching
Thalassaemia Intermedia (β-TI)	8	3	37.5%	5	Moderate DAT positivity; less frequent transfusion than β-TM but alloimmunisation risk persists
Sickle Cell Disease (HbSS)	6	1	16.7%	5	Lower positivity rate; anti-erythrocyte antibodies may complicate delayed haemolytic transfusion reactions
HbS/β-Thalassaemia (S/β)	2	0	0.0%	2	All negative in this series; small sample size limits interpretation
HbE/β-Thalassaemia (E/β)	1	0	0.0%	1	Single case; insufficient data for pattern analysis
Total	35	14	40.0%	21	—

Table No. 5: Distribution of transfusion reaction grades by age group

Age Group	No.	Grade A (Severe)	Grade B (Moderate)	Grade C (Mild)	Grade D (None)	Total	% A+B
Infant (<1 yr)	2	-	1	1	-	2	50.0%
Early Childhood (1–4 yrs)	10	-	5	5	-	10	50.0%
Middle Childhood (5–9 yrs)	47	1	32	14	-	47	70.2%
Early Adolescence (10–14 yrs)	43	1	30	12	-	43	72.1%
Late Adolescence/Adult (≥15 yrs)	6	-	5	0	1	6	83.3%
Total	108	2	73	32	1	108	—

Table No. 6: Distribution of transfusion reaction grades according to type of the disease

Diagnosis (consolidated)	Sub-group (n)	Grade A	Grade B	Grade C	Grade D	Total	% A+B
Thalassaemia (Thal / TM / β-TM)	F=82;TM=1;β-TM=2	1	57	26	1	85	68.2%
Thalassaemia Intermedia (IF)	IF=12	0	7	5	0	12	58.3%
Sickle Cell Disease/Feature (SCD/SCF)	SS=2; SCA=1; SF=3	1	5	0	0	6	100.0%
Pure Red Cell Aplasia (PRCA)	PRCA=3	0	2	1	0	3	66.7%
Aplastic Anaemia (AA)	AA=1	0	1	0	0	1	100.0%
Factor X Deficiency	n=1	0	1	0	0	1	100.0%
Total	—	2	73	32	1	108	—

DISCUSSION

This study is the first comprehensive assessment of the practice of hemovigilance, Positive Direct Antiglobulin Test and extended Rh phenotypes in patients with hereditary blood diseases in Basra, Southern Iraq. The blood group O frequency, along with the high frequency of Rh(D) positive individuals in this population, is similar to the other studies published in Iraq and neighbouring Middle Eastern countries.[7-9] The distribution of hereditary blood disease patients is similar to that of blood donors and other regional populations, indicating that patients with blood diseases are representative of the regional population. However, local knowledge of the blood group frequency is still a key element in blood inventory management and donor recruitment strategy, especially in chronic transfusion centers.

This indicates that R1r and R1R1 were the most common combinations of Rh phenotypes when extended Rh phenotyping was performed. Similar results have been documented in Saudi Arabia and Kuwait and these phenotypes are also common in the Arab populations of these countries.[19,20] Low frequency of the E antigen found in this study is clinically relevant as anti-E antibodies are one of the most common transfusion dependent patients' alloantibodies. Many E-negative patients may be susceptible to alloimmunization and extended antigen matching should be routinely used.

In 40% of the patients tested, DAT positivity was observed, being the highest in patients of β-thalassemia major. This rate is higher than several previously published studies and is possibly due to the cumulative immune response from repeated exposure to transfusion.[14,15] Chronic antigenic stimulation can lead to the formation of both alloantibodies and autoantibodies, which can lead to positive DATs and make future transfusion management more complex. The high rate of positivity is more likely in β-

thalassemia major as the subjects usually undergo regular transfusion from childhood.

The hemovigilance analysis showed that moderate transfusion reaction was the predominant adverse event. There were very few severe reactions, less than 2% of all the responses monitored. These results are comparable to those reported internationally, where febrile non-hemolytic, and allergic reactions are the most common complications of transfusion.[21,22] A large proportion of the moderate reactions were not life-threatening, but there was a significant burden of moderate reactions in terms of patient and healthcare service consequences.

This study showed that majority of reactions was in the younger age groups, which is consistent with the age distribution of the transfusion dependent population. Likewise, the majority of transfusion episode and adverse reaction occurred in thalassemia patients, pointing to the high clinical impact of this disease in southern Iraq. The fact that the reactions were more frequent in the male patients is intriguing, and previous reports on sex differences in transfusion immunology have been inconsistent. The results of this study are in favor of extended Rh and Kell antigen testing of chronically transfused patients. The previous studies have shown that antigen matched transfusion programs can decrease the incidence of alloimmunisation and enhance the long-term outcome of transfusion.[10,11,13]

Further improving transfusion safety can be achieved through routine leukoreduction, frequent DAT testing and organised reporting of adverse events. The advantages of this study are that a large number of children were included, the Rh phenotyping was comprehensive, a real-time electronic database was used and a hemovigilance assessment was integrated. Several constraints must however be noted. This study was performed at a single tertiary center and detailed identification of all alloantibodies was not available in all DAT-positive patients. In addition, the retrospective study design restricted the evaluation of long-term clinical results related to alloimmunisation.

In general, we achieved a good baseline data for developing evidence-based transfusion policies and national hemovigilance initiatives in Iraq. The results highlight the need for improved transfusion safety by broadening Rh and Kell antigen matching, implementing routine leukoreduction, systematic monitoring of DAT and structured reporting of hemovigilance.

CONCLUSION

The extended Rh phenotyping revealed R1r and R1r1 as the major Rh phenotypes, whereas the presence of the E antigen was relatively low, it could be an additional risk factor responsible for alloimmunization in chronically transfused patients. DAT positivity was frequently seen, especially in the cases of patients with β-thalassemia major, showing the significant immunological burden of repeated transfusion therapy. Evaluation of hemovigilance adverse events revealed that moderate transfusion reactions were most common while severe reactions were rare.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Basim A. Al-Hijaj, Ali K. Jumaa
Drafting or Revising Critically:	Zaynab R. Qasim, Qutaiba M. Dawood
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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Original Article

Evaluation of Some Nutrient Sodium, Potassium and Magnesium levels with Leukemia Patients in Thi-Qar Province, Iraq

Zainab S. Hamoud and Jamal Harbi Hussein Alsaadi

ABSTRACT

Objective: The study aimed to determine serum sodium (Na), potassium (K), and magnesium (Mg) levels in patients with ALL, AML and CML in Thi-Qar Governorate, and to evaluate their variations according to sex, and age. It also aimed to assess the distribution of the studied disease groups by age, sex, and residence and to determine serum Na, K, and Mg concentrations using commercial kits and an atomic absorption analyzer

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the Hematology Consultation Unit, Al-Nasiriya Teaching Hospital, Thi-Qar Governorate, Iraq and the "biochemistry Laboratory" at the "College of Science", University of Thi-Qar, Iraq from November 2025 to April 2026.

Methodology: The study included 99 subjects: 20 with acute lymphoblastic leukaemia, 22 with acute myeloid leukaemia, 31 with chronic myeloid leukaemia, and 26 healthy controls, aged 20–85 years. Serum sodium, potassium, and magnesium levels were measured using commercial kits and an atomic absorption analyser. The results were analysed according to age, sex, residence, and disease group.

Results: The distribution of age and sex varied significantly between the groups ($p < 0.01$). Serum sodium was significantly higher in males than females in acute lymphoblastic leukaemia and acute myeloid leukaemia. Magnesium showed a significant sex-related difference in acute lymphoblastic leukaemia, whereas potassium showed no significant difference. Serum sodium increased significantly with age in acute myeloid leukaemia patients.

Conclusion: Age and sex may influence serum micro nutrients levels in haematological malignancies, particularly sodium and magnesium, while potassium showed no significant sex-related variation. residence showed no significant difference among the group ($p>0.05$).

Key Words: Leukemia, Sodium, Potassium, Magnesium, Age, Sex, Residence.

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INTRODUCTION

The term "leukemia" refers to a group of hematological cancers that are distinguished by the uncontrolled proliferation of abnormal blood cells.[1] Different types of this cancer exist, including chronic myeloid leukemia (CML), chronic lymphocytic leukemia (CLL), acute myeloid leukemia (AML) and acute lymphoblastic leukemia (ALL). ALL is distinguished by the proliferation of immature lymphoid cells, whereas, AML is associated with the accumulation of myeloid blasts and impaired cellular differentiation.[1,2] CML originates from hematopoietic stem cells and is characterized by abnormal proliferation of myeloid-lineage cells, while CLL involves the accumulation of monoclonal mature B lymphocytes.[3,4] "Malignant WBCs of ALL are characterized via disorderly abnormal leukocyte proliferation. Thus, leading to overproduction of lymphoblast infiltration into the blood stream and bone marrow elements resulting in a distinct disease state."[5]

Micro nutrients are crucial for preserving regular physiological processes, such as fluid balance, cellular metabolism, and enzymatic activity. Alterations in micro nutrients concentrations have been reported in patients with hematological malignancies.[6] Sodium and potassium are important for normal cellular and physiological functions, and their balance may

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influence hematopoietic stem-cell proliferation and differentiation.[7] Magnesium is an essential divalent cation involved in several enzymatic processes related to energy metabolism, protein and nucleic acid synthesis, as well as cardiovascular and neuromuscular functions.[8]

"The capacity of certain minerals like magnesium to influence the immune system has drawn more attention in the recent years".[9]

METHODOLOGY

The "Al-Nasiriya Teaching Hospital in Thi-Qar Governorate" and the "biochemistry Laboratory" at the "College of Science" served as the study's locations between November (2025) to April (2026). 99 study case were included in this study, 73 patients which divided into four groups (acute leukemia were included in this study, (20 ALL, 22 AML and 31 CML) with control group of the normal healthy individuals 26 with ages ranging from 20 to 85 years.

Exclusion Criteria: Patients with cancers other than leukemia or with CLL, inflammatory or chronic diseases, active autoimmune disorders, acute or chronic infections, and those taking antioxidant, trace-element, or multivitamin supplements within the previous 4 weeks.

Blood Samples: Each participant gave around four milliliters of venous blood, which was then deposited in gel tubes and left at room temperature for 15-20 minutes before being centrifuged at 3000 rpm for 10 minutes were excluded. Pregnant or lactating women and smokers were also excluded. Serum Na, K and Mg concentrations were measured using Kits and atomic absorption analyzer

Statistical analysis was performed using SPSS-26 and Windows version 26.0.

RESULTS

1. Clinical and Characteristic Features of the:

1.1: Sex Distribution: The sex distribution differed no significantly among the examined groups ($p > 0.05$). Males predominated in CML, whereas females predominated in AML and ALL. The control group showed an equal sex distribution, as shown in Table (1).

1.2: Age Distribution: Age distribution showed no significant difference among the studied groups ($P > 0.05$). The 36–60 years age group was predominant in CML, AML, and the control group, while the 20–35 years group was predominant in ALL. Among patients, a significant difference in age distribution was observed ($P < 0.05$). A significant difference in mean age was observed between ALL patients, with the lowest mean age in ALL patients (Table 2).

Table No. 1: Distribution of subjects according to sex.

Groups	Male		Female		Total	
	No.	%	No.	%	No.	%
CML	18	58.06	13	41.94	31	25.41
AML	6	27.27	16	72.73	22	18.03
ALL	9	45.00	11	55.00	20	16.39
Control	13	50.00	13	50.00	26	21.32
Total	55	45.08	67	54.92	122	100
Between groups $CalX^2$= 5.082 $TabX^2$= 7.815 DF= 3 p. value >0.01**						
Between patients $CalX^2$= 4.926 $TabX^2$= 5.991 DF= 2 p. value >0.01**						

Table No. 2: Distribution of subjects according to age.

Groups	20 - 35 years		36 – 60 years		≥ 61 years	
	No.	%	No.	%	No.	%
CML	7	22.58	18	58.06	6	19.35
AML	4	18.18	11	50.00	7	31.82
ALL	10	50.00	10	50.00	0	0.00
Control	5	19.23	12	46.15	9	34.62
Total	28	22.95	63	51.64	31	25.41
Between groups $CalX^2$= 3.298 $TabX^2$= 15.51 DF= 6 p. value >0.01**						
Between patients $CalX^2$= 10.649 $TabX^2$= 12.59 DF= 4 p. value <0.01**						

Groups	Mean ± S. D + Range	
CML	48.2 ± 13.4 (21 - 67)[a]	p. value <0.01** LSD 8.55
AML	53.6 ± 17.0 (23 - 85)[a]	
ALL	36.8 ± 13.1 (20 - 58)[b]	
Control	51.4 ± 16.1 (20 - 75)[a]	

P-value ≤ 0.05 considered significant*

At the 0.05 level, the mean difference is significant*

(a, b): Different letters in the same column indicate a significant difference ($P < 0.05$), whereas identical letters indicate a non-significant difference ($P > 0.05$)

LSD: Least Significant Difference

2. Evaluation of Serum Nutritional Elements Levels in Relation to Sex: As shown in Table (3), serum Na levels showed a significant difference in AML and ALL patients ($p < 0.05$), with higher levels in males than females, while the other groups showed non-significant differences. Serum K levels showed no noticeable variations between the groups studied ($p > 0.05$). Serum Mg levels showed no significant differences in CML and AML ($p > 0.05$), whereas ALL showed a significant difference, with higher levels in females than males.

3. Evaluation of Serum Na Level in Relation to Age: The results showed a significant age-related increase in serum Na levels in AML patients, while a non-significant increase was observed in ALL. In contrast, CML patients showed a non-significant decrease with increasing age, as shown in Table (4).

4. A Spearman correlation between involved parameters in Patients groups: Significant correlations ($P < 0.05$) were observed between age and selected mineral elements, as well as among several minerals in leukemia groups, with both positive and negative associations. These findings suggest variations in mineral relationships with age and across leukemia types as shown in Table (5).

5. Distribution of subjects according to Residence: As shown in Table (6), Residence distribution showed no significant difference among the studied groups ($P > 0.05$). Rural residents were more frequent in CML and the control group, whereas urban residents were more frequent in AML and ALL.

Table No. 3: Serum Na, K and Mg levels of studied groups to sex.

Groups	Sex	Na Median + Range	K Median + Range	Mg Median + Range	p-value Mann–Whitney U
CML	M	0.17 (0.10–1.74)	0.020 (0.00–0.13)	0.002 (0.00–0.01)	Na: 0.211
	F	0.19 (0.16–0.30)	0.013 (0.00–0.11)	0.001 (0.00–0.01)	K: 0.514
					Mg: 0.465
AML	M	0.80 (0.01–0.12)	0.036 (0.00–0.08)	0.022 (0.00–0.03)	Na: 0.014*
	F	0.02 (0.01–0.23)	0.022 (0.00–0.07)	0.003 (0.00–0.01)	K: 0.407
					Mg: 0.115
ALL	M	0.52 (0.02–0.08)	0.007 (0.00–0.03)	0.003 (0.00–0.01)	Na: 0.021*
	F	0.05 (0.02–0.08)	0.007 (0.00–0.09)	0.006 (0.00–0.01)	K: 0.824
					Mg: 0.025*

Table No. 4: Serum Na levels of studied groups to age groups.

Groups	Age Groups	Na Median + Range	p. value Kruskal-Waillis H Mann-Whitney U
CML	**20-35 years**	0.204 (0.18 – 0.51)	0.266
	36-60 years	0.187 (0.10 – 1.74)	
	≥ 61 years	0.185 (0.19 – 0.21)	
AML	**20-35 years**	0.018 (0.01 – 0.12)^{b}	0.024*
	36-60 years	0.038 (0.01 – 0.16)^{ab}	
	≥ 61 years	0.059 (0.01 – 0.23)^{a}	
ALL	**20-35 years**	0.046 (0.02 – 0.09)	0.218
	36-60 years	0.075 (0.03 – 0.09)	

Table No. 5: A Spearman correlation between involved parameters in Patients groups.

Group	Parameter / Correlation	r.value	P.Value
CML	Ag vs Na	-0.422	0.018
	Ag vs Mg	0.376	0.037
AML	K vs Mg	0.626	0.002
	Ag vs Mg	-0.484	0.022
ALL	Ag vs K	0.512	0.021

r :Spearman correlation coefficients

Table No. 6: Distribution of subjects according to Residence

Groups	Rural		Urban		Total	
	No.	%	No.	%	No.	%
CML	15	48.39	16	51.61	31	25.41
AML	8	36.36	14	63.64	22	18.03
MM	14	60.87	9	39.13	23	18.85
ALL	7	35.00	13	65.00	20	16.39
Control	17	65.38	9	34.62	26	21.32
Total	61	50.00	61	50.00	122	100
Between groups $CalX^2$= 30.6 $TabX^2$= 9.41 DF= 4 p. value <0.01**						
Between patients $CalX^2$= 18.0 $TabX^2$= 7.81 DF= 3 p. value <0.01**						

DISCUSSION

Sex Distribution: Sex-related biological differences, including chromosomal and epigenetic mechanisms, may influence gene expression and illness risk.[10] In line with the current investigation, females had greater rates of AML.[11]According to Munroe et al. (2025)[12] females also had greater rates of ALL. This discrepancy could be due to biological variables linked to sex, sample size and demographics.[13]

Age Distribution: According to Mohammad and Nadim (2024)[14] the second age group had the greatest number of patients, with the highest rates of CML, AML, and ALL, whereas the third group had the lowest rates of CML and ALL. According to Hu et al. (2024)[15], There was a substantial age difference, with the lowest mean age in ALL (36.8 ± 13.1 years). According to Aljabban and Alalsaidissa (2024)[16], there was a notable age-related variance in AML classifications. Leukemia age distribution may be influenced by genetic, environmental, radiation, chemical, and therapy-related factors; nonetheless, treatment costs and follow-up issues continue to be problems in underdeveloped nations.[17]

Evaluation of Serum Micro nutritional Elements Levels in Relation to Sex: The findings revealed that serum sodium levels among ALL and AML patients differed significantly by gender, with males having greater levels. possibly as a result of sex-related variations in hormone regulation, renal sodium processing, and body water balance.[18] Furthermore, "hormone act as work on Fluid retention, the kidney start to keep high amount of Na and high amount of water"[19] While females showed a small non-significant rise, no significant differences were found in the other groups. Due to sex-related variations in hormone control, magnesium absorption, renal processing, and estrogen-mediated metabolism, female patients with ALL exhibited considerably higher serum magnesium levels than male patients.[20] The greater serum magnesium levels seen in females may be explained by sex-related variations in magnesium metabolism.

Evaluation of Serum Na Level in Relation to Age: Age-related changes in renal function, thirst, and ADH control may explain the significant increase in serum Na levels with age in AML patients.[21] This increase may be related to comorbidities and decreased functional reserve in older AML patients.[22]

A Spearman correlation between involved parameters in Patients groups: The positive correlation between K and Mg may reflect their interdependent roles in electrolyte homeostasis, as magnesium contributes to cellular potassium regulation and its deficiency can enhance potassium loss. The observed mineral correlations may also reflect leukemia-associated disturbances in mineral metabolism and cellular homeostasis, which can vary among leukemia types.[23]

Distribution of subjects according to Residence. The variation in residence distribution may be related to differences in environmental exposure, population distribution, and access to healthcare services. Similar finding have been reported by Papandreou (2025).[24]

Abbreviations:

Asymbol	Interpretation
ALL	Acute Lymphoblastic Leukemia
AML	Acute Myeloid Leukemia
$CalX^2$	Calculated Chi-Square Value
CLL	Chronic Lymphocytic Leukemia
CML	Chronic Myeloid Leukemia
Control	Normal healthy group
DF	Degrees of Freedom
F	Female
K	Potassium
LSD	Least significant difference
M	Male
Mg	Magnesium
Na	Sodium
No	Number of subjects
SPPS	Statistical Package for the Social Sciences
$TabX^2$	Tabulated(Critical) Chi-Square
WBCs	White Blood Cells

CONCLUSION

This study concluded that significant sex-related differences were observed in ALL, AML and CML. The mean age also differed significantly, with the lowest mean age in ALL Serum Na showed significant differences by sex in AML and ALL and increased significantly with age in AML. Serum K showed no significant differences, while serum Mg showed a significant sex-related difference in ALL.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Zainab S. Hamoud, Jamal Harbi Hussein Alsaadi
Drafting or Revising Critically:	Zainab S. Hamoud, Jamal Harbi Hussein Alsaadi
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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Original Article

Biochemical Assessment of Serum Hepcidin, Ferritin and Transferrin Saturation in Pregnant Women with Iron Deficiency Anemia in Thi-Qar Province – Iraq

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ABSTRACT

Objective: To assess serum hepcidin, ferritin, and transferrin saturation levels in pregnant women with iron deficiency anemia, and to explore their interrelationships as well as their possible diagnostic value as a combined biomarker panel

Study Design: Case-control observational study

Place and Duration of Study: This study was conducted at the outpatient antenatal clinics of Al-Nasiriyah Teaching Hospital, Thi-Qar Province – Iraq, from 15th August 2025 to 30th June 2026.

Methodology: Ninety pregnant women in their second and third trimesters were recruited, 60 women with iron deficiency anemia and 30 healthy pregnant controls. Venous blood samples were taken for the estimation of complete blood count, serum iron, total iron binding capacity, ferritin and hepcidinby enzyme-linked immunosorbent assay. Transferring saturation was computed as serum iron/total iron binding capacity.

Results: Compared with controls, women with iron deficiency anemia exhibited significantly lower levels of hemoglobin, ferritin and transferring saturation, with markedly reduced hepcidin concentrations (P<0.001 for each). Hepcidin correlated well with ferritin (r=0.71) and transferring saturation (r=0.62) and moderately with hemoglobin. Receiver operating characteristic analysis showed hepcidin had an excellent discriminative capacity for iron deficiency anemia (AUC = 0.91).

Conclusion: The addition of hepcidin to the standard iron parameters and its potential as a supplementary marker to improve the diagnosis of iron deficiency anemia in pregnancy.

Key Words: Iron deficiency anemia, Transferrin saturation, Pregnancy, Iron homeostasis, Ferritin.

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INTRODUCTION

Iron deficiency anemia (IDA) is the most common nutritional anemia known to occur in pregnancy. The World Health Organization estimates that nearly 40% of pregnant women worldwide are anemic and the majority of these cases are, at least in part, due to iron deficiency.[1] The disease is not only affect maternal well-being, but has also been reported to be associated with premature delivery, low birth weight, impaired neurocognitive development of the offspring and an increased risk of peripartum mortality.[2] Pregnancy is a major physiological stress on iron storage, mostly due to plasma volume expansion, fetal requirements and placental needs that increase the daily iron requirements considerably beyond what most diets can readily provide.[3]

Ferritin and transferrin saturation (TSAT) are the most extensively used biochemical indicators of iron status, but both have important limits in pregnancy.[4] The levels of ferritin are affected by inflammation and the TSAT shows a marked circadian rhythm.[5] More recently, hepcidin, a short 25 amino acid hepatic peptide, has been identified as the key regulator of iron homeostasis, regulating intestinal iron absorption and the release of iron from macrophages through its

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interaction with ferroportin.[6] When iron availability is low, hepcidin expression is suppressed, in theory allowing greater absorption and mobilization of iron, while inflammation produces the opposite effect.[7]

The non-pregnant populations have demonstrated a fairly tight relationship between hepcidin and iron markers.[8] However, data in pregnant women, especially those with overt IDA, remains comparatively limited. Moreover, regional variations in dietary habits, parasitic burden, and supplementation practice make it desirable to generate locally relevant data.[9]

METHODOLOGY

A case–control observational study was carried out at the outpatient antenatal clinics of Al-Nasiriyah Teaching Hospital, Thi-Qar Province – Iraq from 15th August 2025 to 30th June 2026 letter No. 7/54/624 dated 3rd August 2025. A total of 90 pregnant women were enrolled, of whom 60 were diagnosed with IDA and 30 were age- and gestation-matched healthy pregnant women. The diagnosis of IDA was based on the WHO definition (hemoglobin<11 g/dL during pregnancy) accompanied by a serum ferritin value below 30 ng/mL.[10]

Inclusion criteria for both groups were maternal age between 18 and 40 years; singleton pregnancy in the second or third trimester (gestational age 14-36 weeks); and willingness to provide written informed consent. Exclusion criteria were: multiple pregnancy, known hemoglobinopathies (e.g. thalassemia, sickle cell disease), chronic inflammatory or infectious disorders, recent blood transfusion (within 3 months), recent iron therapy (within 1 month), hepatic or renal dysfunction, history of malignancy and any acute infection at the time of sampling. Women with overt obstetric problems like pre-eclampsia or gestational diabetes were also eliminated to reduce confounding.[11]

Venous blood (about 8 mL) was collected from each participant, generally between 08:00 and 10:00 following an overnight fast, to minimize diurnal variation of iron-related indicators. The sample was separated into two aliquots, 2 mL in an EDTA tube for complete blood count and the remainder 6 mL in a plain serum separator tube. After complete clotting at room temperature, the latter was centrifuged at 3,000 rpm for 10 minutes; serum was then separated, distributed into aliquots, and stored at −80°C until analysis. Samples were thawed only once to limit assay drift, and all analyses were carried out within three months of collection.[12]

Complete blood count (CBC), including hemoglobin (Hb), red blood cell count (RBC), hematocrit (Hct), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and red cell distribution width (RDW), was performed using an automated hematology analyzer (Sysmex XN-1000, Kobe, Japan). Serum iron and total iron-binding capacity (TIBC) were measured by the ferrozine colorimetric method on an automated chemistry analyzer. Transferrin saturation (TSAT, %) was calculated using the standard equation: TSAT=(serum iron/TIBC)×100. Serum ferritin was quantified by an immunoturbidimetric assay calibrated against the WHO international standard. Serum hepcidin-25 was measured using a commercially available enzyme-linked immunosorbent assay (ELISA) kit (DRG International, USA), strictly following the manufacturer's instructions. All assays were performed in duplicate; intra- and inter-assay coefficients of variation remained below 8% and 10%, respectively.[13]

Data were analyzed using SPSS-31. Shapiro-Wilk tested continuous variables for normality. Group comparisons were performed using the independent-samples t-test or the Mann-Whitney U test and categorical variables were examined using the chi-square test. Pearson or Spearman correlation coefficients were used between variables according to the distribution of data. The diagnostic contribution of hepcidin, ferritin and TSAT was simulated using multivariate logistic regression. Receiver operating characteristic (ROC) curves were utilized to evaluate the diagnostic performance of these markers alone and in combination as a panel, reporting the area under the curve (AUC) with 95% confidence intervals. Two-sided P-values <0.05 were significant.

RESULTS

The demographics of the participants and obstetric features were shown in Table 1. The hematological parameters are explained in Table 2. The serum iron, TIBC, ferritin and TSAT are summarized in Table 3. IDA significantly reduced serum hepcidin levels in pregnant women compared to controls (Table 3). Correlation analysis revealed that hepcidin was positively and significantly associated with ferritin, and inversely correlated with TIBC as shown in Table 4 and Figure 1.

ROC curve study analyzedhepcidin, ferritin, and TSAT diagnostic accuracy (Figure 2). Hepcidin had an AUC of 0.91 (95% CI: 0.85-0.96) with a cut-off of 7.8 ng/mL, sensitivity of 87% and specificity of 89%. Ferritin showed an AUC of 0.94 (95% CI: 0.89-0.98) at a cut-off of 18 ng/mL and TSAT 0.88. The AUC increased modestly to 0.96 as a panel using logistic regression, suggesting that the addition of hepcidin to ferritin and TSAT increases diagnostic value, especially in borderline or unclear cases. Hepcidin is not redundant, even if ferritin alone performed marginally better in this group. Its key strength is identifying women with inflammation who may have difficulty interpreting ferritin according to traditional cut-offs.

Table No. 1: Demographic and clinical characteristics of pregnant women with IDA and healthy pregnant controls

Characteristic	IDA (n = 60)	Control (n = 30)	P-value
Maternal age (years), mean±SD	27.1±7.4	26.4±4.7	0.71
Gestational age (weeks), mean±SD	23.5±6.3	24.6±5.2	0.63
BMI (kg/m²), mean±SD	23.8±1.7	23.2±2.6	0.66
Parity, median (range)	3 (0–4)	3 (0–5)	0.72
Primigravida, n (%)	14 (23.3)	8 (26.7)	0.71
Urban residence, n (%)	38 (63.3)	19 (63.3)	0.93
Previous iron supplementation, n (%)	22 (36.7)	13 (43.3)	0.54
Education ≥ secondary, n (%)	41 (68.3)	22 (73.3)	0.61

Table No. 2: Comparison of hematological parameters between pregnant women with IDA and healthy pregnant controls

Parameter	IDA (n = 60)	Control (n = 30)	P-value
Hemoglobin (g/dL)	7.9±0.9	12.8±1.1	<0.001
RBC count (×10⁶/µL)	3.68±0.57	4.31±0.36	<0.001
Hematocrit (%)	29.6±3.2	37.2±2.4	<0.001
MCV (fL)	74.6±6.2	88.4±4.7	<0.001
MCH (pg)	24.1±2.7	29.6±1.9	<0.001
MCHC (g/dL)	30.4±2.1	33.5±2.2	<0.001
RDW (%)	17.7±2.1	12.2±2.3	<0.001

Table No. 3: Serum iron status parameters in pregnant women with IDA and healthy pregnant controls

Parameter	IDA (n = 60)	Control (n = 30)	P-value
Serum iron (µg/dL)	38.1±12.4	84.6±18.3	<0.001
TIBC (µg/dL)	446±52	358±41	<0.001
Transferrin saturation (%)	8.6±3.4	23.8±6.1	<0.001
Ferritin (ng/mL), median (IQR)	8.2 (4.1-14.6)	38.4 (24.7-55.2)	<0.001
Hepcidin (ng/mL), median (IQR)	3.4 (1.8-5.9)	18.6 (12.4-25.3)	<0.001

Table No. 4: Correlation coefficients between serum hepcidin and selected hematological and iron parameters across the combined study population (n = 90).

Parameter	Correlation coefficient (r)	P-value
Hemoglobin (g/dL)	0.52	< 0.001
Serum ferritin (ng/mL)	0.71	< 0.001
Serum iron (µg/dL)	0.59	< 0.001
TIBC (µg/dL)	−0.41	< 0.001
Transferrin saturation (%)	0.62	< 0.001
MCV (fL)	0.44	< 0.001
RDW (%)	−0.39	< 0.001

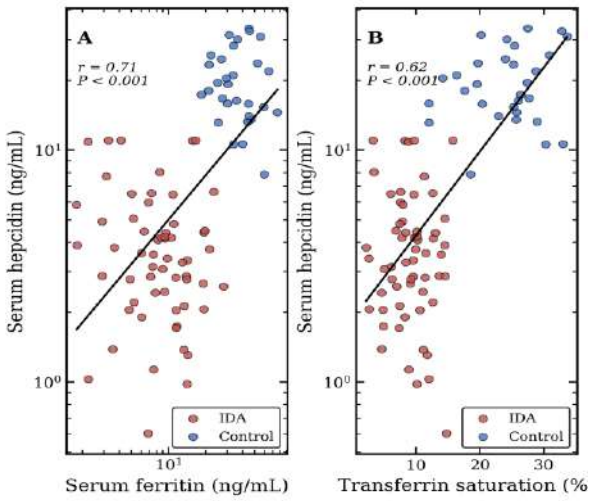


Figure No. 1: The relationship between serum hepcidin and (A) serum ferritin and (B) transferrin saturation in the combined study population. Black solid lines represent the linear regression fit (on log-transformed scales where appropriate).

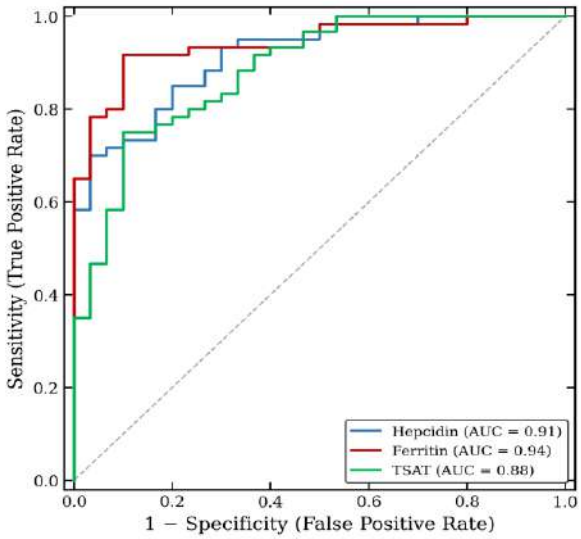


Figure No. 2: Receiver operating characteristic (ROC) curves for serum hepcidin, ferritin, and transferrin saturation in distinguishing pregnant women with iron deficiency anemia from healthy controls. The dashed diagonal indicates the line of no discrimination (AUC = 0.50). Corresponding AUC values are reported in the legend.

DISCUSSION

The present study revealed that hepcidin is reduced physiologically in IDA women compared to controls. Low hepcidin stabilizes ferroportin on the basolateral membranes of enterocytes, thereby permitting absorption of dietary iron and release of iron from macrophages and hepatocytes.[14] In women with minimal iron stores before pregnancy or in low-resource situations, inhibition of hepcidin alone is not

enough to restore iron status, and the woman moves from iron-depleted stores to iron-deficient erythropoiesis and anemia.[15] The extent of this suppression is consistent with the well-known notion that iron deficit downregulates hepcidin transcription, maximizing iron uptake and mobilization.[16] Many researchers believe that hepcidin is a better indicator of real iron shortage than ferritin, especially when systemic inflammation raises ferritin. The narrow interquartile range in the IDA group in our dataset shows that hepcidin suppression is a common aspect of pregnancy-related iron depletion, not a rare finding.[17]

The strength of association with ferritin closely mirrors what has been reported in non-pregnant populations and suggests that, even during pregnancy, ferritin remains an important determinant of hepcidin expression.[18] However, in a small subset of women in the IDA group with relatively higher ferritin (likely reflecting subclinical inflammation), hepcidin levels remained low; this implies that, at this stage of pregnancy, the iron-deficiency signal often outweighs the inflammatory drive on hepcidin regulation.[19]

In addition, iron status does not only affect hepcidin. Erythroferrone can be more inhibitory to hepcidin when erythropoiesis increases, which is essential in late pregnancy.[13] Inflammatory cytokines, such as IL-6, can counter these signals and increase hepcidin, leading to functional iron insufficiency even in the absence of a substantial reduction in total body iron.[20] The interplay of these competing inputs may explain some of the dispersion in our association study and is a reminder to always interpret hepcidin in a clinical situation.[21]

Our findings agree with many researchers found significantly lower hepcidin levels in iron-deficient pregnant women from European cohorts. Indian, Egyptian, Iranian, and sub-Saharan populations show similar patterns, but absolute hepcidin values vary between studies due to biological differences and methodological heterogeneity, especially in ELISA platform.[7-9] The cut-off of ~7.8 ng/mL in our cohort aligns with previously established limits, but should not be blindly applied to other labs.[22] This reinforces the idea that local reference intervals for hepcidin are needed before routine use. Hepcidin suppression with declining ferritin has also been found in neighboring nations, supporting the regulatory relationship.[23]

CONCLUSION

The pregnant women with iron deficiency anemia have lower serum hepcidin, ferritin, and transferrin saturation than healthy pregnant controls. Hepcidin was tightly associated with ferritin and TSAT and was an effective prenatal IDA diagnostic tool, the hepcidin's role as a central regulator of iron homeostasis and its potential as a supplementary biomarker for the iron panel. Hepcidin is particularly beneficial when ferritin interpretation is hampered by inflammation or borderline readings, which is typical in clinical practice. The integrating hepcidin measurement into prenatal anemia evaluation, but more prospective and interventional studies are needed to establish trimester-specific reference ranges and determine if it can predict iron therapy responsiveness. An integrated strategy may enhance diagnosis, treatment, and maternal and newborn outcomes.

Author's Contribution:

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Original Article

Educational Program on Patients' Knowledge of Medication Therapy after Percutaneous Coronary Intervention

Zainab R. Lafta

ABSTRACT

Objective: To evaluate an education program to improve patient knowledge of their prescribed medications after they have had a percutaneous coronary intervention

Study Design: Quasi-experiment study

Place and Duration of Study: This study was conducted at the Al-Nasiriyah Heart Center in Thi-Qar Iraq, from 19th March 2025 to 25th May 2026.

Methodology: Randomly chosen from the population of 100 patients, 50 were assigned to the Study Group and 50 to the Control Group. The study group and control group each had 50 participants. Data were collected using a standardized survey with two components; demographics & section, medication knowledge post percutaneous coronary intervention (n=16 items).

Results: Majority of the study group participants were aged 54 to 60 years, with males comprising 64%. Primary school education was the most frequent level (28%), Worker constituted 56% of the occupational distribution, and 90% were married. Pre-test assessments indicated a poor baseline knowledge level (82%) among the study group, whereas post-test evaluations demonstrated a 100% good knowledge level, reflecting statistically significant improvements.

Conclusion: Implementation of the educational program substantially enhanced patient awareness regarding medication management after percutaneous coronary intervention.

Key Words: Knowledge, Medication, Percutaneous coronary intervention.

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INTRODUCTION

Percutaneous Coronary Intervention (PCI) stands as a globally prevalent medical intervention.[1] This revascularization technique serves elective purposes for managing angina in stable coronary artery disease or urgent interventions for acute coronary syndromes.[2] A primary advantage of successful PCI involves enhancing myocardial perfusion while circumventing the extended recovery associated with coronary artery bypass surgery. Although major complications remain uncommon, mortality risks persist.[3] Post-procedural ischemic events primarily stem from platelet-driven mechanisms that cause thrombus development at sites of mechanical plaque rupture, alongside distal embolization into the coronary microvasculature.[4] Furthermore, the long-term efficacy of endovascular procedures can be constrained by subsequent reinfarction, stent thrombosis, and restenosis. Nevertheless, administering proper dosages of antiplatelet agents successfully mitigates these complications.[5] Antiplatelet management serves as a crucial adjunctive treatment for minimizing ischemic complications following PCI.[6] As an oral thienopyridine antiplatelet medication, clopidogrel selectively and permanently blocks platelet ADP receptors. Utilizing clopidogrel post-intervention has evolved into standard practice for secondary cardiovascular risk reduction. The therapeutic efficacy of clopidogrel in PCI patients, with prevailing guidelines advocating its use for a minimum duration of 12 months.[4]

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METHODOLOGY

This quasi-experiment study was carried out at Al-Nasiriyah Heart Center in Thi-Qar Iraq from 19th March 2025 to 25th May 2026. The total number of

participants sampled for the study was 100 patients that were randomly assigned into one of two sample groups with an equal distribution of fifty (50) participants in each sample group (control group and study group). A structured data collection instrument with two sections was used to collect information from the study participants. The first section gathered demographic variables encompassing six items (age, gender, educational level, occupational status, marital status and monthly income, while the second section evaluated patient comprehension regarding post-percutaneous coronary intervention medication therapy through 16 questions. Content validity was established through expert review, and instrument reliability was assessed via a pilot study. Statistical evaluation of the data was conducted using SPSS-26, applying both descriptive and inferential analytical methods.

RESULTS

The analysis of demographic data indicated that the largest percentage of participants in the study group ranged in age from 54 to 60 years. Males constituted the largest share of the sample at 64%. Regarding educational attainment, primary school education was most prevalent, accounting for 28% of the cohort. Occupational distribution indicated that 56% of the patients were laborers, while the vast majority, 90%, reported being married (Table 1).

Overall knowledge assessments demonstrated that study group participants exhibited a deficient baseline level of understanding during the pre-test phase at 82%, which shifted entirely to a proficient level at 100% during the post-test evaluation, signaling a substantial transformation in cognitive awareness. Conversely, the control group maintained predominantly poor knowledge levels across both the pre-test (84%) and post-test (94%) periods (Table 2).

Comparative statistical evaluations confirmed that the educational program exerted a highly significant positive impact on participants' medication comprehension following percutaneous coronary intervention, as demonstrated by a strong statistical significance at a p-value of 0.001 within the study cohort. In contrast, the control group displayed no significant differences between evaluation periods (Table 3).

Table No. 1: Distribution of patients according to their demographic variables (n=100)

Variable	Study Group (n=50)		Control Group (n=50)	
	No.	%	No.	%
Age (years)				
28 – 35	1	2.0	-	-
36 – 43	4	8.0	7	14.0
44 – 51	22	44.0	16	32.0
52 – 59	21	42.0	24	48.0
Gender				
Male	32	64.0	30	60.0
Female	18	36.0	20	40.0
Level of education				
Read & write	11	22.0	8	16.0
Primary school	14	28.0	22	44.0
Intermediate school	10	20.0	9	18.0
Secondary school	5	10.0	5	10.0
Diploma	3	6.0	4	8.0
University	7	14.0	2	4.0
Occupation				
Unemployed	9	18.0	11	22.0
Worker	28	56.0	24	48.0
Employee	13	26.0	10	20.0
Retired	-	-	5	10.0
Marital status				
Single	-	-	-	-
Married	45	90.0	49	98.0
Widowed/er	5	10.0	-	-
Divorced	-	-	1	2.0
Monthly income				
Insufficient	31	62.0	32	64.0
Barely sufficient	15	30.0	15	30.0
Sufficient	4	8.0	3	6.0

Table No. 2: Overall assessment of patients' knowledge about medication therapy post percutaneous coronary intervention

Levels of knowledge	Study Group (n=50)						Control Group (n=50)					
	Pre-test			Post-test			Pre-test			Post-test		
	No.	%	Mean±SD	No.	%	Mean±SD	No.	%	Mean±SD	No.	%	Mean±SD
Poor	41	82.0	2.98±2.83	-	-	15.18±089	42	84.0	3.42±2.58	47	94.0	3.59±2.57
Fair	8	16.0		-	-		7	14.0		3	6.0	
Good	1	2.0		50	100.0		1	2.0		-	-	

Table No. 3: Educational program on patients' knowledge about medication therapy post percutaneous coronary intervention

Knowledge	Study Group (n=50)					Control Group (n=50)				
	Mean±SD	t	df	P value	Sig.	Mean±SD	t	df	P value	Sig.
Pre-test	2.98±2.83	31.419	49	0.001	HS	3.42±2.58	2.428	49	0.124	NS
Post-test	15.18±0.89					2.59±2.57				

DISCUSSION

Analysis of the demographic variables indicated that the largest age cohort within the study group ranged between 44 and 60 years, representing 44% of the participants - a finding consistent with Oliveira-Filho et al[7], who observed a prominent age group around 52 years. Males predominated the sample at 64%, which aligns with the gender distribution reported by Saleem et al.[8] Regarding education, individuals with primary school education formed the largest segment at 28%, corroborating the results of Bisiriyu.[9] Occupationally, laborers constituted 56% of the cohort, supporting observations by Hajialibeigloo et al[10] concerning working demographics. Additionally, married individuals accounted for 90% of the sample, matching patterns noted by Bisiriyu[9] while 62% reported insufficient monthly income, reinforcing findings by Abd-Ali and Al-Rubaiyee[11] regarding low-income patient populations.

Baseline evaluations revealed that participants initially exhibited a deficient level of medication comprehension during the pre-test phase. Conversely, post-test assessments demonstrated a proficient standard of knowledge, indicating a substantial cognitive improvement. These results correspond with Saud and Hassan[12] and Al-Najjar[13] who similarly noted poor pre-intervention drug awareness followed by significant post-test enhancements.

A statistically significant difference was observed in patients' medication knowledge before and after the implementation of the instructional program within the study group.. This upward shift underscores the clear efficacy of the structured educational intervention. These findings parallel those of Windecker et al[14], who recorded improved post-test scores following educational training, and Magadza et al[15], who documented a marked increase in medication-related understanding upon completion of a targeted teaching program.

CONCLUSION

Implementation of the educational program substantially enhanced patient awareness regarding medication management after percutaneous coronary intervention.

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Original Article

Indoor Air Quality and Environmental Safety in Neonatal Intensive Care Unit in Al-Najaf, Iraq: A Cross-Sectional Study of Incubators and Surrounding Air

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ABSTRACT

Objective: To measure selected indoor air quality parameters within neonatal incubators and neonatal intensive care unit rooms using a calibrated digital monitoring device

Study Design: Descriptive analytical cross-sectional study

Place and Duration of Study: This study was conducted at the neonatal intensive care unit of Al-Zahraa Teaching Hospital in Al-Najaf, Iraq, from 1st October 2024 to 31st March 2025.

Methodology: The study included 12 active neonatal Incubators and two neonatal intensive care unit rooms. Air quality parameters including temperature, relative humidity, particulate matter ($PM_{1.0}$, $PM_{2.5}$ and PM_{10}), carbon dioxide, formaldehyde, and total volatile organic compounds, were measured using a portable monitoring device. Measurements were conducted during peak working hours at different locations within the rooms and incubators.

Results: The research results demonstrated that the majority of air quality indicators met international standards for acceptable levels. The temperature and carbon dioxide levels met the recommended values, but relative humidity fell below the recommended threshold. The $PM_{2.5}$ and PM_{10} levels remained within acceptable range while formaldehyde and total volatile organic compounds gaseous pollutants appeared at extremely low levels. The two rooms showed no significant statistical differences between them ($P>0.05$).

Conclusion: The neonatal intensive care unit indoor air quality assessment showed acceptable results although the facility needed humidity level improvements. The establishment needs continuous air quality assessment together with control systems to maintain protection for neonates

Key Words: Indoor air quality, Neonatal incubators, Particulate matter, Environmental monitoring.

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INTRODUCTION

Indoor air quality (IAQ) establishes an essential health standard which applies to all environments but healthcare facilities need special consideration because they serve vulnerable patient groups who spend all their time indoors. The term IAQ describes indoor air conditions present in various buildings which include hospitals and homes and schools because multiple physical and chemical and biological elements affect its measurement. The rising use of cleaning products and disinfectant materials and synthetic substances leads to indoor environments where pollutants reach levels that are two to five times higher than outdoor air pollution, especially in locations with poor ventilation systems.[1,2]

In healthcare facilities, optimal IAQ maintenance serves as a critical factor that protects against infections while ensuring patient safety. The combination of inadequate ventilation and inappropriate temperature and humidity settings together with poor air filtration system maintenance creates an environment where dangerous airborne substances including particulate matter and microbial agents can build up.[2,3] Ventilation systems equipped with high-efficiency particulate air (HEPA) filters function as essential components that decrease airborne particles while preventing infection spread in critical care settings like neonatal intensive care units (NICUs).[4,5]

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Carbon dioxide (CO_2) acts as a ventilation efficiency measurement tool because its high level indicates that ventilation systems fail to provide proper air circulation, which leads to increased indoor pollutant buildup.[6,7] Airborne particle levels in hospital units rise because of human presence together with daily clinical work that includes staff movement and equipment transport activities.[8]

Indoor air pollution in indoor spaces consists mostly of particulate matter, especially the smaller $PM_{2.5}$ and PM_{10} particles. The particles can stay airborne for long periods because they enter the respiratory system, which creates major health hazards. The World Health Organization[1] reports that people who experience high levels of PM exposure face greater chances of developing respiratory and cardiovascular diseases. The risk for NICU patients increases because preterm infants lack fully developed respiratory systems and immune systems, which makes them vulnerable to airborne pollutants and infectious diseases.

The hospital air contains a combination of airborne particles and chemical substances and microorganisms. The healthcare environment contains airborne bacteria which include Staphylococcus and Bacillus and Pseudomonas as common findings that demonstrate their capacity to spread healthcare-associated infections.[9,10] A study carried out in NICUs showed significant air contamination together with the detection of multidrug-resistant organisms which confirmed that environmental air functions as an infection transmission path.[11] A recent systematic review of research from 2019 to 2024 confirmed that indoor air quality (IAQ) in healthcare settings shows inconsistent results because healthcare facilities do not follow recommended standards in their compliance practices.[12]

Iraqi research conducted at the local level has found that hospital indoor air quality shows high levels of indoor air pollution which includes both particulate matter and CO_2 and volatile compounds. The results indicate that there might be problems with both the ventilation systems and the control systems.[13-16] A recent study conducted in Karbala hospitals, which was published in Al-Furat Journals for health and medical sciences, documented various neonatal health conditions among hospitalized newborns while showing how healthcare environment affects neonatal health outcomes.[17]

The research project intends to evaluate indoor air quality in neonatal incubators and their surrounding neonatal care areas through measurements of particulate matter and gaseous pollutants and environmental conditions which will help identify possible exposure hazards in NICUs.

METHODOLOGY

A descriptive analytical cross-sectional study conducted in the Neonatal Intensive Care Unit of Al-Zahraa Teaching Hospital in Al-Najaf, Iraq 1st October 2024 to 31st March 2025 letter No. 3434/QM/Approval/ JSDJNEHU dated 7th September 2024. The NICU composed two active rooms containing incubators in use. During the study period, 12 incubators were actively in use. Indoor air samples were collected from active neonatal incubators and surrounding NICU rooms. Active incubators and operational NICU rooms were included. Non-operational incubators and inactive rooms were excluded.

Air quality was monitored using a portable air quality monitor (Model: PV28-CW, manufactured in China). The device is capable of measuring temperature, relative humidity, $PM_{1.0}$, $PM_{2.5}$, PM_{10}, HCHO, TVOC, and CO_2. It utilizes a laser scattering sensor for particulate matter, a semiconductor sensor for gaseous pollutants. The device was calibrated according to the manufacturer's instructions for prior to use. Measurements were conducted in the two active NICU rooms and for all active incubators n =12. In each room, measurements were taken at three different locations: near the sink, at the center of the room, and at the far end, to represent the overall environmental conditions. The parameters measured in the rooms included temperature, relative humidity, particulate matter (PM_{10} and $PM_{2.5}$), HCHO, and TVOC.

For incubators measurements were taken for all incubators when the incubator was temporarily unoccupied, in coordination with the healthcare staff, to ensure patient safety and avoid any interference with neonatal care. The parameters measured included temperature, relative humidity, particulate matter ($PM_{1.0}$, $PM_{2.5}$), HCHO, TVOC and CO_2. All measurements were taken during peak working hours (10:30 AM to 12:00 PM). The device was placed at each location for approximately 10 minutes before recording the readings to ensure stability and accuracy. For statistical analysis, parameters with established reference values were compared to international guidelines using a one-sample t-test. A P-value equal to or less than 0.05 was considered statistically significant.

RESULTS

The mean temperature was 30.0±2.13C ranging from 27.0-33.0C. The mean relative humidity was 38.08±3.87 with values between 32.0% 43.0 % indicating slight variation. The average CO_2 concentration was 726.33±94.63 ppm. $PM_{2.5}$ showed a mean of 14.92±16.17 $\mu g/m^3$, with values between 1.0 and 48.0 $\mu g/m^3$. The mean HCHO concentration was 0.002±0.003 mg/m^3 (range: 0.001-0.013 mg/m^3). Likewise, TVOC levels were low, with a mean of 0.014 ±0.043 mg/m^3 and a range of 0.001-0.152mg/m^3. There were non-statistically significant (P>0.05) differences between room1 and room2 regarding air quality parameters (Table 1).

Table No. 1: Air quality parameters measured inside neonatal incubators

Parameter	Neonatal Incubator Room 1		Neonatal Incubator Room 2		Total		P value
	Mean± D	Range	Mean±SD	Range	Mean±SD	Range	
Temp (C)	30.0±1.89	27.0-33.0	30.0±2.53	27.0-33.0	30.0±2.13	27.0-33.0	1.000
Hum (%)	39.5±3.51	34.0-43.0	36.67±3.98	32.0-42.0	38.08±3.87	32.0-43.0	0.220
CO_2 (PM)	734.5±118.41	616-960	718.17±74.28	653-850	726.33±94.63	616-960	0.781
$PM_{2.5}$ (µg/m^3)	12.83±17.48	1.0-48.0	17.0±16.11	4.0-41.0	14.92±16.17	1.0-48.0	0.677
HCHO (mg/m^3)	0.003±0.005	0.001-0.013	0.002±0.001	0.001-0.003	0.002±0.003	0.001-0.013	0.526
TVOC (mg/m^3)	0.026±0.062	0.001-0.152	0.003±0.001	0.001-0.005	0.014±0.043	0.001-0.152	0.369

The mean temperature (30.0±2.13C) did not differ significantly from the reference value (30C) (P=1.000). In contrast, relative humidity (38.08±3.87%) was significantly lower than the reference value 45% (P<0.001). The mean CO_2 concentration (726.33±94.63 ppm) showed no statistically significant differences when compared to the reference value of 800 ppm (P= 0.056). $PM_{2.5}$ levels (14.92±16.17µg/m^3) did not differ significantly from the reference value of 15 µg/m³ (P=0.825). HCHO (0.002±0.003 mg/m^3), and TVOC (0.014±0.043 mg/m^3) were significantly (P<0.001) lower than their respective reference values (Table 2).

Table No. 2: One sample t. test of comparison between the value of air quality parameters and reference values

Parameter	Mean± SD	Reference Value	P value
Temp (C)	30.0±2.13	30°C	1.000
Hum (%)	38.08±3.87	45	<0.001
CO_2 (ppm)	726.33±94.63	800 ppm	0.056
$PM_{2.5}$ (µg/m³)	14.92±16.17	15 µg/m³	0.825
HCHO (mg/m³)	0.002±0.003	0.1 mg/m³	<0.001
TVOC (mg/m³)	0.014±0.043	0.3 mg/m³	<0.001

One sample t. test

The $PM_{1.0}$ level showed a mean value of 12.08±12.48 µg/m³ indicating variability in ultrafine particle levels detection throughout measurements. The $PM_{1.0}$ parameter was analyzed descriptively due to the absence of established international reference values (Table 3).

The mean temperature was 24.67±1.51C, ranging from 23.0 to 27.0C. The mean relative humidity was 42.50±1.23%, with values ranging from 41.0 to 44.0%. For particulate matter, the mean PM_{10} level was 12.60±3.73 µg/m^3, while $PM_{2.5}$ had a mean of 8.97±4.32 µg/m^3, ranging from 1.0 to 14.0 µg/m^3. The mean formaldehyde (HCHO) concentration was 0.004±0.007 mg/m^3, with a range of 0.001-0.019 mg/m^3. TVOC levels showed a mean of 0.038±0.086 mg/m^3, ranging from 0.001 to 0.214 mg/m^3. While There were non-statistically significant (P>0.05) differences between room1 and room2 regarding air quality parameters (Table 4).

The temperature did not differ significantly from the reference value (P=0.611). Relative humidity was significantly lower than the reference value (P=0.004). PM_{10} and $PM_{2.5}$ levels were significantly lower than their respective reference values (P=0.005 and P=0.019, respectively). HCHO, and TVOC were significantly (P<0.001) lower compared to the reference value (Table 5).

Table No. 3: The descriptive statistical of $PM_{1.0}$ level inside neonatal incubators

$PM_{1.0}$	Mean± SD	Measurement unit
	12.08±12.48	µg/m^3

Table No. 4: Air quality measurements in neonatal rooms

Parameter	Room 1		Room 2		Total		P value
	Mean± D	Range	Mean±SD	Range	Mean±SD	Range	
Temp (C)	25.67±1.16	25.0-27.0	23.67±1.16	23.0-25.0	24.67±1.51	23.0-27.0	0.101
Hum (%)	43.33±0.58	43.0-44.0	41.667±1.16	41.0-43.0	42.50±1.23	41.0-44.0	0.089
PM_{10} (µg/m^3)	14.20±0.20	14.0-14.4	11.0±5.19	5.0-14.0	12.60±3.73	5.0-14.4	0.347
$PM_{2.5}$ (µg/m^3)	9.27±0.252	9.0-9.5	8.667±6.81	1.0-14.0	8.97±4.32	1.0-14.0	0.886
HCHO (mg/m^3)	0.001±0.001	0.001-0.002	0.007±0.010	0.01-0.019	0.004±0.007	0.001-0.019	0.363
TVOC (mg/m^3)	0.002±0.002	0.001-0.005	0.074±0.122	0.001-0.214	0.038±0.086	0.001-0.214	0.367

Table No. 5: One sample t. test of comparison between the value of air quality parameters and reference values

Parameter	Mean ± SD	Reference Value	P value
Temp (C)	24.67±1.51	25°C	0.611
Hum (%)	42.50±1.23	45	0.004
PM_{10} (µg/m³)	12.60±3.73	45 µg/m³	0.005
$PM_{2.5}$ (µg/m³)	8.97±4.32	15 µg/m³	0.019
HCHO (mg/m³)	0.004±0.007	0.1 mg/m³	<0.001
TVOC (mg/m³)	0.038±0.086	0.3 mg/m³	<0.001

DISCUSSION

This study evaluated indoor air quality in neonatal incubators and NICU rooms, finding that most parameters met international standards except for relative humidity which showed substantial decreases from normal levels. The results show that most conditions are acceptable, with specific areas requiring improvemen.[2]

The temperature readings in both incubators and room areas matched the established standards which demonstrated proper temperature control throughout the NICU. Maintaining appropriate temperature is essential for neonatal stability, especially for preterm infants with immature thermoregulation.[5]

The relative humidity level was found to be lower than 45% which is the recommended threshold, and this condition may harm neonatal health because it increases their risk of developing skin dryness and mucosal irritation and becoming more vulnerable to infections. In healthcare settings, which lack proper humidity control, similar results have been documented.[3]

The carbon dioxide levels stayed within safe limits because they did not differ from established reference values which proved that ventilation systems operated effectively. The standard practice for assessing ventilation performance uses CO^2 levels which indicate adequate air exchange when measurements fall below 800 ppm.[7]

The air quality of the incubators and rooms showed effective performance because the $PM_{2.5}$ and PM_{10} particulate matter levels stayed below the maximum allowed limits. International research evidence supports these findings by showing that hospitals need to control airborne particles to reduce their patients' respiratory health risks.[1,7]

Gaseous pollutants formaldehyde HCHO and total volatile organic compounds TVOC were present at extremely low levels which fell far below established reference values. The results show minimal chemical contamination which demonstrates effective ventilation and disinfectant control in the NICU environment. Hospital-based research showed the same results because VOC levels remained low while proper ventilation and environmental management systems were in place.

Due to the lack of standardized reference values, PM1.0 was analyzed descriptively. The observed variability results from changes in human activities and equipment usage which previous studies have documented in the NICU environment.[7]

The two NICU rooms showed no important differences which indicated that the unit maintained consistent environmental control methods throughout the facility. Regional studies demonstrated identical results because they found that hospital units maintained stable environmental conditions even though their building structures differed.[13,16]

The majority of incubators achieved acceptable air quality standards which confirmed that indoor air quality maintained sufficient levels for medical use. The ongoing drop in humidity levels shows that better environmental control methods must be developed. These findings are consistent with previous Iraqi study which demonstrated that hospital environmental conditions directly affect neonatal health outcomes.[17]

CONCLUSION

The most measured environmental parameters were within acceptable international standards. Temperature, carbon dioxide, particulate matter ($PM_{2.5}$ and PM_{10}), formaldehyde, and total volatile organic compounds were generally within safe limits, indicating adequate environmental control within the unit. However, relative humidity was consistently below the recommended level, highlighting a potential risk factor that may affect neonatal comfort and vulnerability to infection. Overall, the findings suggest that while the neonatal intensive care unit environment is generally safe, continuous monitoring and improvement of humidity control and ventilation systems are essential to ensure optimal protection for neonates.

Author's Contribution:

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Original Article

Evaluation of Students' Perceptions of the Educational Environment during Curricular Transition at a Dental College in Pakistan Utilising the DREEM Inventory

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ABSTRACT

Objective: The aim of this study was to assess undergraduate dental students' perceptions of the educational environment with respect to the transition of the curriculum with DREEM

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the Women Dental College, Abbottabad, Pakistan, from December 2025 to April 2026.

Methodology: Among the 200 invited students, 134 responded (67%). A 50-item DREEM inventory was used to assess perceptions, and scores were compared between the integrated modular and traditional curriculum groups.

Results: The mean total DREEM score for the integrated modular group was greater than that for the traditional group, but this difference was not statistically significant (123.68 ± 35.27 vs. 113.65 ± 28.92, p = 0.077). Teachers could improve by using more teacher-centered approaches, providing positive feedback, facilitating factual learning, and providing support for the students.

Conclusion: There were no statistically significant differences between the two groups; however, perceptions were more favourable within the integrated modular group. Improving students' teaching, feedback and psychosocial support can enhance the educational environment.

Key Words: DREEM, educational environment, dental education, integrated curriculum, curricular transition, undergraduate dental students.

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INTRODUCTION

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The educational environment is a critical determinant of academic performance, professional development, motivation, and psychological well-being in health profession education.[1] This includes pedagogies, curriculum design, evaluation, teacher–student relationships, institutional assistance, and the learning atmosphere.[2] A positive educational environment fosters active learning, critical thinking, and professional competence, whereas a negative environment may adversely affect learning outcomes and student satisfaction.[3]

Dental education has shifted from traditional discipline-based curricula towards integrated modular approaches emphasising competency-based, student-centered, and interdisciplinary learning.[4-5] However, gradual curricular implementation may expose different cohorts to distinct educational approaches.[6]

Students' perceptions of the curriculum can be assessed to gauge the effectiveness of the curriculum and what needs to be done to improve it.[7,8]

The Dundee Ready Educational Environment Measure (DREEM) is a 50-item validated self-reported measure for five domains of the educational environment, and some institutional strengths and weaknesses are revealed by the measure.[9,10]

The integrated modular curriculum was followed by first- and second-year BDS students at Women Dental College (WDC), whereas third- and final-year students implemented the traditional curriculum. Given the lack of evidence from such a transitional context in Pakistan[11], the present study investigated students' perceptions of the educational environment via DREEM.

METHODOLOGY

Study Design and Setting: This cross-sectional study was carried out at Women's Dental College (WDC) Abbottabad, Pakistan, from December 2025 to April 2026 and aimed to evaluate undergraduate dental students' perceptions of the educational environment via the DREEM inventory. The integrated modular curriculum was followed by first-year and second-year students during the study, whereas third-year and final-year students continued with the discipline-based curriculum because of the gradual, cohort wise implementation of the curricular reform.

Study participants and sampling: This research involved all undergraduate BDS students from the first year to the final year at the WDC who were enrolled during the study period. Participation in the study was voluntary, and students interested in the study were asked to provide informed consent. Students who did not complete the questionnaires or refused to participate were excluded. The total population sampling technique was utilised[12] and 134 completed questionnaires were used in the final analysis.

Study instrument: The DREEM inventory[9] was used to measure students' perceptions of the educational environment. The 50-item questionnaire measures five areas: 'Students' Perception of Learning' (12 items), 'Students' Perception of Teachers' (11 items), 'Academic Self-Perception' (8 items), 'Atmosphere' (12 items), and 'Social Self-Perception' (7 items). The responses were scored according to the standard DREEM system (0--4), with negatively worded items reverse-scored[13] (Items 4, 8, 9, 17, 25, 35, 39, 48, and 50). The maximum score is 200, and the higher the score is, the better the educational environment. The overall scores were interpreted on the basis of the DREEM guidelines.[14]

The overall DREEM scores were interpreted on the basis of established guidelines: 0--50; 'very poor', 51--100; 'plenty of problems', 101--150; 'more positive than negative', 151--200; and 'excellent educational environment'. These categories were used to interpret the overall students' perceptions of the educational environment[14].

Data collection procedure: After ethical approval was obtained, the students were invited to participate in the study. The purpose of the study was explained, and informed consent was obtained from the students willing to participate. The questionnaires were completed anonymously, with no involvement from the faculty, to reduce response bias.

Statistical analysis: The data were analysed via IBM SPSS Statistics version 20. Descriptive statistics were used to calculate the mean ± standard deviation (SD) for continuous variables, including DREEM scores and domain scores, whereas frequencies with percentages were used for categorical variables, such as academic year and curriculum type (integrated modular or traditional curriculum). A t test was used to compare the mean total DREEM scores between students enrolled in the integrated modular curriculum and those following the traditional curriculum. The overall and item-level DREEM scores were computed and interpreted following the standard guidelines.

Ethical considerations: The study was approved by the Institutional Ethical Review Committee of WDC. The study was conducted on a voluntary basis, and participants' confidentiality and anonymity were ensured throughout the study.

RESULTS

A total of 134 completed questionnaires were used in the final analysis (see Figure 1 for class-wise representation).

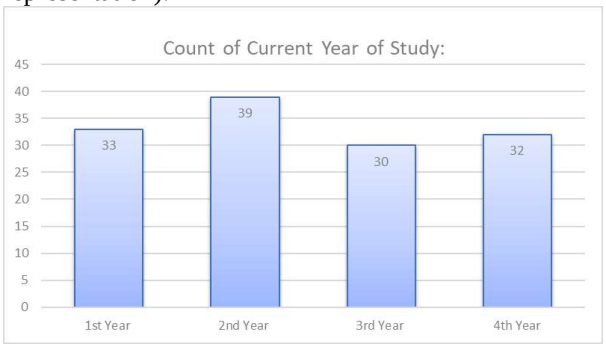


Figure No. 1: Total No. of Participants

The mean global DREEM score was 119.13 out of 200 (SD = 32.50), indicating that the educational environment was 'more positive' than negative'. This means that the students' overall impression of the learning climate was positive, but there were some weaknesses, as shown in Table 1.

Table No. 1: Total DREEM score measure

Total DREEM score Measure	Value	Interpretation
Total Respondents	134	Modular = 72 Traditional = 62
Mean Global DREEM Score	119.13/200 (SD = 32.50)	'More positive than negative'

For the domain analysis, the highest proportional score was for 'Students' Academic Self-Perception', and the lowest was for 'Students' Social Self-Perception'. The item-level analysis of the DREEM inventory identified specific areas with relatively low mean scores. These included Q9 ('the teachers are authoritarian'), Q25 ('the teaching overemphasises factual learning'), Q48 ('the teaching is too teacher-centred'), Q32 ('the teachers provide constructive criticism'), and items related to student stress, loneliness and boredom (see Table 2 for details).

The most obvious concern at the item level was teacher authoritarianism. The report indicates that the item with the lowest mean score in the entire inventory was Q9, 'teachers are authoritarian', with a mean score of 1.57. A lack of constructive criticism and a teacher-centered approach were also noted as problem areas in the same section. The social domain was also weak, with poor support for stress, frequent loneliness and boredom identified as ongoing issues (see Table 3 for details).

Compared with the traditional curriculum group, the integrated modular group had a greater mean total DREEM score (123.68 ± 35.27 vs. 113.65 ± 28.92), with a mean difference of 10.04 points (95% CI −1.10--21.17; p = 0.077; Cohen's d = 0.31). However, this difference was not statistically significant (p = 0.077). The lack of statistical significance may partly reflect the sample size and variability within the groups and should not necessarily be interpreted as an absence of a meaningful difference. (See Table 4).

The results collectively indicate a learning environment that is generally satisfactory but not yet fully student-centered. Students' self-confidence in their academic skills was the strongest element, whereas the weakest elements were related to social support, feedback, and the teacher–student relationship. The overall picture indicates that curricular change was evident in the student experience, but pedagogical style and pastoral support remain to be addressed if the educational climate is to be consistently positive.

Table No. 2. DREEM domain scores

Subscale	Mean Score	Maximum	SD	% of Max	Interpretation
Students' Perception of Learning (SPL)	**28.77**	48	7.96	59.9%	More positive than negative
Students' Perception of Teachers (SPT)	**25.57**	44	6.62	58.1%	Moving in the right direction
Students' Academic Self-Perception (SASP)	**20.01**	32	6.56	62.5%	More on the positive side
Students' Perception of Atmosphere (SPA)	**29.08**	48	9.67	60.6%	More positive than negative
Students' Social Self-Perception (SSSP)	**15.70**	28	4.83	56.1%	Poor

Table No. 3. Main problem areas identified in the report

Q#	Question	Subscale	Mean	SD	Priority
Q3	There is a good support system for students who get stressed	SSSP	1.96	1.46	**MODERATE**
Q4	I am too tired to enjoy this course [NEG → reversed]	SSSP	1.96	1.27	**MODERATE**
Q9	The teachers are authoritarian [NEG → reversed]	SPT	1.57	1.11	**HIGH**
Q14	I am rarely bored during this course	SPA/SSSP	1.84	1.32	**MODERATE**
Q25	The teaching over-emphasises factual learning [NEG → reversed]	SPL	1.60	1.05	**HIGH**
Q28	I seldom feel lonely	SSSP	1.85	1.30	**MODERATE**
Q32	The teachers provide constructive criticism here	SPT	1.77	1.25	**MODERATE**
Q48	The teaching is too teacher-centered [NEG → reversed]	SPL	1.89	1.17	**MODERATE**

Table No. 4. Comparison of reported curriculum groups

Domain	Modular (Yr 1–2)	Traditional (Yr 3–4)	Mean Diff. (95% CI)	t (df)	p value	Cohen's d
Total DREEM Score	123.68 ± 35.27 (n=72)	113.65 ± 28.92 (n=62)	10.04 (−1.10 to 21.17)	1.783 (132)	0.077	0.31

DISCUSSION

The findings of the present study indicate that students' overall perceptions of the educational environment were 'more positive than negative' and that the mean global DREEM score was 119.13/200 ± 32.50. This result is similar to those of previous studies in dental and medical education. The overall positive score does not reflect all aspects of the educational environment. Similarly, Ali et al. (2012) reported a mean score of 115.06 and reported that 197 final-year BDS students from five dental institutions at the University of Health

Sciences, Lahore, Pakistan, had nine remediation items.[11] In 2018, Jamil et al. reported favourable perceptions among students of the integrated curriculum at Sindh Medical College and Liaquat National Medical College, Karachi; however, the curriculum differed from the one evaluated in the present study, with relative strengths in academic and social self-perception.[15] Stormon et al. reported positive perceptions among dental students at the University of Queensland, Australia, but with some areas that needed improvement, specifically academic and social self-perception.[16]

The lowest scoring item was teacher authoritarianism, and other items, such as inadequate constructive feedback, teacher-centered teaching, emphasis on factual learning, and limited support for stressed students, were also highlighted. Two research papers from India by Patil and Chaudhari and Bhosale reported similar findings, identifying gaps in learning due to authoritarian teaching methods, factual learning, teacher-centered approaches, and an inadequate student support system.[17,18] They recommend that curricular changes be implemented along with faculty development programs for student-centered teaching, facilitation skills, interactive learning, communication and feedback in a constructive manner.

Notably, one of the lowest scores in the instrument was 'Students' Social Self-Perception' (56.1%). This does not necessarily mean that it is a highly negative environment but that there may be greater concerns about students' social and psychosocial experiences. Stormon et al. reported similar results and hypothesised that academic burden, curricular transition, insufficient peer interaction, or missing student support may be contributing factors.[16] However, these cannot be determined from the DREEM inventory data itself. An increase in mentoring, peer support activities, academic advice, and identification of students who are experiencing stress may thus be beneficial. This could be further investigated through qualitative studies to explore in depth the underlying reasons for these perceptions.

This cross-sectional study revealed that students with an integrated curriculum had a better numerical trend in DREEM scores than did students with a traditional curriculum. This finding is in line with Yasmeen and Anwar's study[19], who reported that with an integrated curriculum, students received high scores on DREEM at Islamic International Medical College, Rawalpindi. However, this cannot be explained only in terms of changes in learning and teaching, curriculum design, students' workload, clinical exposure, assessment requirements, and faculty training. This suggests that the findings indicate a positive trend rather than definitive evidence of curricular superiority.[20] Similarly, this study cannot definitively conclude that higher scores in the modular curriculum were solely due to curricular changes; they may also reflect a gradual positive trend over the years.

Overall, the results indicated that the reorganisation of content is not enough to achieve successful curricular transition. For integrated education to yield the desired results, the following factors are important: faculty preparedness, student-centered teaching, constructive feedback, and psychosocial support. A continuous process of measure-intervention-reassess, which is based on DREEM, may be useful for determining priority areas, designing faculty development and student-support interventions in priority areas, and tracking subsequent progress in the educational setting.

CONCLUSION

Overall, the study suggests a positive educational environment during curricular transition, with a positive numerical trend in the integrated modular stream. The primary shortcomings are teacher-centered practices, inadequate constructive feedback, and inadequate social support. With systematic attention to these areas, the educational climate should transition to a more student-centered and supportive environment, in line with the objectives of contemporary dental education.

Strengths:

- This study employed DREEM, a validated and widely used tool for the evaluation of educational environments in medical and dental schools.
- The anonymity of the data collection process with no faculty involvement seemed to have minimised response bias and increased student honesty in their responses.
- The study included all available BDS cohorts during an ongoing curricular transition, enhancing the practical relevance of the findings for curriculum evaluation.

Limitations:

- The study was conducted at one dental college, and the results may not be generalizable to other dental colleges because of contextual differences.
- The modular and traditional groups were from different academic years, and differences may be reflected in the training stage.

Recommendations

- Student-centered teaching, a reduction in authoritarian teaching behavior, and constructive feedback should be priorities for faculty development.
- The DREEM assessment should be repeated when the curriculum is fully developed, preferably in a longitudinal design, and compared with that of more than one dental college.
- A follow-up study using mixed methods would be helpful for understanding why students feel that teaching is teacher-centered and that support is weak despite curriculum reform.

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Original Article

In Vitro Determination of the Antibacterial Activity of AgNPs using Syzygium Aromaticum Against Streptococcus Mutans

Mushtaq Talip Hussein

ABSTRACT

Objective: To evaluate the antimicrobial activity of AgNPs with clove extract against Streptococcus mutans and determine their MIC and MBC

Study Design: Controlled, in vitro laboratory experimental study

Place and Duration of Study: This study was conducted at the Department of Basic Sciences, College of Dentistry, Al-Qadisiyah University, Qadisiyah Governorate, Iraq, from 14th Jan 2025 to 20th September 2025.

Methodology: Biosynthesis of SA AgNPs and characterization using UV-Vis, FTIR, XRD, and SEM. The antibacterial activity was determined by the agar well diffusion method then estimate the MIC and MBC.

Results: The XRD pattern of the pure silver sample has a closely match JCPDS card No. 04-0783 with four sharp, visible diffraction peaks appeared at specific 2Θ angles. FTIR spectroscopy of SA AgNPs identified the specific functional groups. High absorption of AgNPs appeared at 421nm in the UV-Vis spectrum. SEM analysis showed a crystalline nature and quasi-spherical form of AgNPs with dimensions 14 - 32 nm. The zones of inhibition for AgNPs synthesized using Syzygium aromaticum were determined using agar well diffusion method. SA AgNPs at a concentration of 20 mg/mL displayed the most potent antibacterial action, producing the largest zone of inhibition measuring 19 ± 0.8 mm. The inhibitory activity was initiated at 0.32 mg/ml, while the MBC was 1.25 mg/ml. The calculated MBC/MIC ratio was determined to be approximately 3.9 (∽4).

Conclusion: The results suggested that Ag nanoparticle synthesis with Syzygium aromaticum can be used as an effective inhibitor of bacterial growth.

Key Words: Silver, Extraction, Clove, Gram-positive, Antibacterial agents.

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INTRODUCTION

One of the important fields is Nanotechnology. There is an intersection between the biomedical sciences and nanotechnology and act to produce novel substances with therapeutic ability. AgNPs have antibacterial, anticancer, and catalytic applications because of their physicochemical characteristics. The synergistic action of clove extract and silver nanoparticles produces a bioactive substance with antibacterial activity.[1] Tooth caries was an important type of biofilm-mediated illness that contains several types of cariogenic.[2] Teeth caries lead to occurrence of cardiovascular diseases.[3] Oral conditions play effective roles in the accepted caries etiology.[4] Frequently, sugars intake leads to acid production, and cause unbalance between acidogenic and none-acidogenic microorganisms.[5] S.mutans was a main causes in the dental caries in 70 to 90 percent, due to it produces lactic acid as well as grows at lower pH. Caries development is depended on the virulence of mouth micro-organisms that participate in its emergence.[6] There are many studies that refer to use clove in treating dental diseases due to antibacterial effects, with fewer side effects and used as toothpaste due to its strong effects and availability and low cost. Cloves oil has two major components, eugenol and β-caryophyllene. The first one has bactericidal effects on several types of bacteria.[7]

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This study aims to evaluate the green synthesis, characterization, antimicrobial activity, and biomedical activity of SA AgNPs under optimized reaction conditions, including temperature, pH and concentrations.

METHODOLOGY

a. Clove extract preparation: Plant sample materials were collected from popular markets in Al- Diwaniyah, Iraq, and the taxonomic identification of the plant was confirmed as Syzygium aromaticum by the Department of Biology at Babylon University, Iraq. The washed plant were sterilized and dried far from light. The dried material was crushed into fine particles. A portion of the powder (2 gram) was dissolved in distilled water (100 mL) by shaking for 48h and filtered on cotton and allowed to cool to 25ºC. To ensure a clear extract, the filtrate was filtered through a Whatman No. [41] filter paper then Centrifugation was performed at 1600 rpm for 10 min. The clarified leachate was concentrated by a rotary vacuum evaporator at reduced pressure and dried at 40 °C. The sample was weighed and stored in a small container in cold conditions at 5 °C until further use.[8]

b. Green synthesis of Ag NPs: The biosynthesis of silver nanoparticles can be performed using a 1 mM solution of $AgNO_3$ and clove extract. Biosynthesis is performed by adding 5 mL of extract to 50ml of 1 mM $AgNO_3$ solution. In the next step, incubation of the mixture carried out at 90 °C for 2 min to complete the reduction process.[9] A stock solution with a concentration of 20 mg/mL was prepared as the final concentration of SA AgNps which used in the antibacterial assay.

c. Characterization of Ag nanoparticles: The methods used to characterize the purified nanoparticles:

1. UV-vis Spectroscopy: UV-vis Spectroscopy (SpectraMax 340 PC, Molecular Devices, Munich, Germany) was used to monitor the biological reduction of Ag+ to Ag0 and measure of the absorption spectra (UV-vis) over a range of 280 to 700 nm. Readings were recorded twice within 15 min.[10]

2. Infrared Spectrophotometer and XRD: An infrared spectrophotometer (Bruker Tensor 27 IR spectrometer) was carried out to identify the clove functional groups. These groups were responsible for capping and reduction of nanoparticles.[11]

To analyze the crystalline structures of the samples, an X-ray diffractometer (XRD) (Shimadzu model: XRD 6000 with CuKα radiation at 1.5406ƛ, operated at 40 kV and 30 mA) was used. Analysis of the shape of the particles was performed by a particle size analyzer (Sympatec GmbH, NANOPHOX).

3. Scanning electron microscopy: Detection of the morphology and size of AgNPs was performed by SEM. The oven-dried SA-AgNP (thin films) were made and provide for use on a carbon –coated copper grid via a TESCAN MIRA-3 instrument operated at an accelerated voltage of 5.0 kV.[11]

d. Antimicrobial activity determination:

1. Bacterial suspension: The bacteria were obtained from the culture collection department of the Micro Lab in Al-Diwanyia Hospital, Iraq. The suspension was made by choosing 3-5 pure colonies. These colonies were suspended in 5mLof sterile saline solution and adjusted to match the 0.5 McFarland

2. Antimicrobial activity of extracts: The well-diffusion method was used to determine the antimicrobial action of the clove extract. The bacterial suspension turbidity was standardized to a 0.5 McFarland. Mueller-Hinton agar was incubated with the bacterial suspension. 6 mm wells were punched into the medium and filled with 100 µL of the various concentrations (100, 50, 25 mg/ml) of Syzygium aromaticum extracts. In the negative control, wells were filled with 100 µL of distilled water. Each plate was incubated for 24 h at 37°C. The zones of inhibition were measured in mm.[12]

3. Antibacterial activities of AgNPs: Streptococcus mutans was cultured onto Mueller-Hinton agar and incubated overnight at 35 °C. A 0.5 McFarland standard was utilized to the turbidity standardization of the suspension of bacteria. The antimicrobial activities of AgNPs synthesized with clove were evaluated and compared with a positive control (Carbenicillin1mg/mL), alongside the clove extract. The agar well diffusion method was used under sterile conditions. After spread of the bacterial suspension, the wells were punched into the medium and filled with 100 µL of the respective treatment, and a negative control was included. The experiments were performed in triplicate. Finally, the MIC and MBC were estimated by microdilution broth test.[12]

4. MIC and MBC determination: The MIC and MBC of AgNPs synthesized by clove extract were determined by the broth microdilution method.[12]

e. Statistical analysis: Data are presented as mean ± standard error of the mean, and all antibacterial assays were conducted in triplicate. Statistical analysis was performed using the standard error of the mean.

RESULTS

a. Characterization of AgNPs:

1. UV-vis spectral analysis: The addition of the SA extracts to the $AgNO_3$ solution led to a distinct color change from origin color (yellow) to brown due to the Ag+ reduction to Ag nanoparticles; this visual change confirmed the synthesis of AgNPs (Figure 1). Figure 2 shows the UV–visible absorption spectra of AgNPs using a 2 mM $AgNO_3$ concentration with a plant extract after 24 hours at 130°C via the autoclave- assisted method. The absorption spectrum extended from 400 to

500 nm, with a maximum surface plasmon resonance peak observed at 421 nm.



Figure No. 1. The color change of solution to brown due to the Ag+ reduction to Ag NPs.

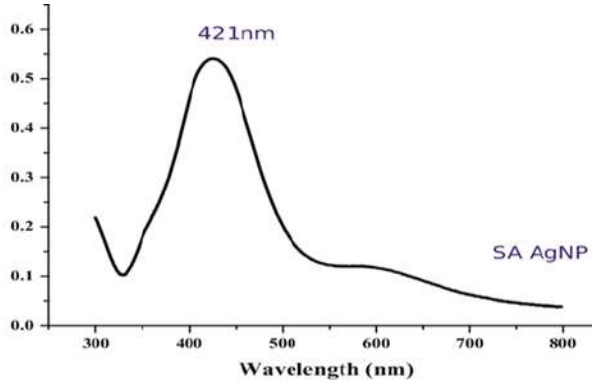


Figure No. 2. The peak AgNPs absorption appeared at 421 nm in the UV-Vis spectrum

2. Functional groups analysis: FTIR spectroscopy of silver nanoparticles with clove extract was groups responsible for reducing silver ions (Ag^{+}) into metallic silver (Ag^{0}) and stabilizing the resulting nanoparticles. Figure (3). (Table 1) utilized to characterize the specific functional groups.

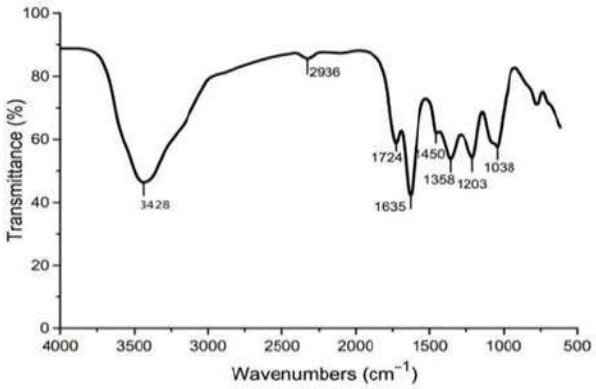


Figure No. 3. FTIR spectrum of SA AgNPs shows peaks and their corresponding functional groups.

Table No. 1. FTIR spectrum of SA AgNPs shows the biomolecules involved in capping and reduction of silver nanoparticles

Approximate Wavenumber (cm^{-1})	Functional Group Assignment	Extend bimolecular source in SA extract
3428	O-H Stretching	Phenolic compounds, flavonoids, and eugenol
2936	C-H Stretching	Aliphatic CH groups
1724	C=O Stretching	Ester group of eugenol estate
1635 → 1610	C=C Stretching	Aromatic rings or allyl group of eugenol and carbonyl groups from proteins, flavonoids, and terpenoids
1450 / 1358	C-H Bending	Organic molecules capping the nanoparticle surface
1203 / 1038	C-O Stretching	Polyols, ethers, or alcoholic groups; phenols

3. XRD characterization synthesized silver nanoparticles: The XRD pattern of the pure Ag sample shows high compatibility with JCPDS card No. 04-0783. The four sharp, distinct diffraction peaks appeared at specific 2Θ angles. These peaks correspond to the (111), (200), (220), and (311) Miller crystal planes (Figure 4). The (111) plane represents the highest intensity (Table 2).

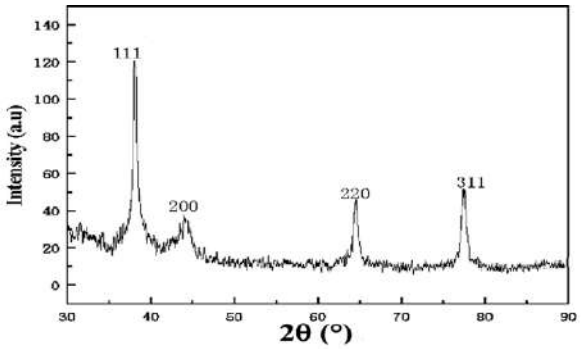


Figure No. 4. Structural characterization and phase purity of synthesized silver nanoparticles.

Table No. 2. XRD data for AgNPs nanoparticles corresponding to the standard FCC phase.

Diffraction (2Θ º) angle	Crystal plane (hkl)	Crystal plane (hkl)
38.1º	(111)	Highest intensity
44.3º	(200)	Medium intensity
64.4º	(220)	Low intensity
77.4º	(311)	Low intensity

4. Scanning Electron Microscopy (SEM): Figure 3 showed the nanoparticles with a predominantly spherical morphology with dimensions ranging from 14 to 32 nm. The observed narrow size distribution aligns well with the results of the UV-Vis spectrophotometric data (Figure 5).

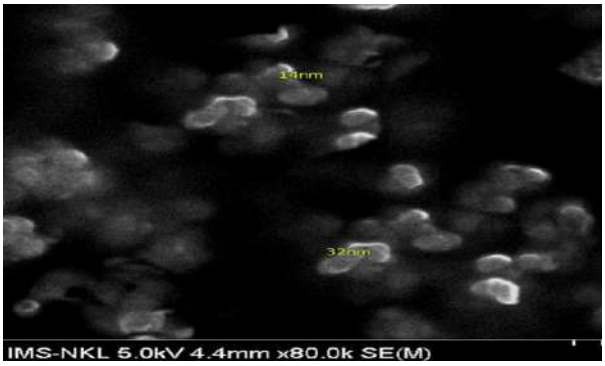


Figure No. 5. The result of SEM showed dimensions ranging from 14 to 32 nm and appeared as spherical symmetry.

f. Estimation of Antibacterial activity: Aqueous clove extract exhibited a clear concentration-dependent antimicrobial efficacy. A 25 mg/mL concentration showed a mean inhibition zone 9±0.5 mm, while 50 mg/mL and 100 mg/ml improved the antibacterial action, producing mean inhibition zones of 11 ± 0.57 mm and 15 ± 1.3 mm, respectively. SA AgNPs at a concentration of 2.5 mg/ml displayed the most potent antibacterial action among all tested materials, producing the largest zone of inhibition measuring 19 ± 0.8 mm. Carbenicillin (1 mg/ml), the positive control, generated a zone of inhibition of 16 ± 0.8 mm, which was lower than the SA AgNPs. In contrast, sterile water (the negative control) showed no inhibitory activity (0 mm) against the tested bacteria - Table (3).

Table No. 3. In vitro antimicrobial effect of aqueous, SA Ag NPs and Carbenicillin against S. mutans

Treatment material	Concentrations	Loading quantity per well	Inhibition zones (mm) (mean ±SR)
Inhibition zones (mm) (mean ±SR)	25mg/mL	100µ	9±0.5
	50mg/mL	100µl	11±0.57
	100mg/mL	100µl	15±1.3
SA AgNPs	20 mg/mL	100µl	19±0.8
Carbenicillin (positive control)	1mg/mL	100µl	16±0.8
Water (negative control)	-	100µl	0

Data are expressed as means of three replicates (n=3) ±standard error.

g. Determination of MIC and MBC of SA AgNPs: Determination of the MIC and MBC of AgNPs were done by the broth microdilution method. The antibacterial activity of the AgNPs with clove extract was recorded in Table (4). The inhibitory activity was initiated at 0.32 mg/ml whereas MBC ranged from 1.25 mg/ml. The calculated MBC/MIC ratio was determined to be approximately 3.9 (∽4).

Table No. 4. MIC and MBC of SA AgNPs

AgNPs	Conc. mg/ml	MBC/MIC Ratio	Antibacterial action
	0.16	3.9(≈4)	Bactericidal
MIC	0.32		
	0.64		
MBC	1.25		
	2.5		
	5		
	10		

DISCUSSION

The current study aimed to synthesize nanoparticles with antibacterial effects using Syzygium aromaticum extract. Several studies have mentioned the microbicidal activity of SA Ag NPs. So, this study was similar to that reported by Alharth et al.[13]

After 24 hours, the result exhibited a brown color, indicating the formation of silver nanoparticles in solution. This aligns with the previous study of Palanivelu et al.[14] The in vitro antibacterial activity results exhibited varying diameters of inhibition zones. There is a direct relationship between the inhibition zone diameter and the concentration of the clove extract due to density of bioactive materials, particularly eugenol - Mansoori et al.[15] Numerous documents indicate the antimicrobial properties of both silver nanoparticles (AgNPs) with clove extract. This potent antimicrobial activity is closely proportionate with recent results of Molina-Trinidad et al[16] and other studies of AgNPs with clove extract, which reported inhibition zones ranging from 18 mm to 20 mm.[17] Devi and Bhaskar demonstrate the eugenol-functionalized nanoparticles give lower Minimum Inhibitory Concentration (MIC) due to cooperating action against oral streptococci.[18] This study findings showed intrinsic differences when compared to recent literature. Our result disagreed with the findings of the study of Elchaghaby et al[19] showed the antimicrobial activity of Ag NPs with star anise extract against S. mutans with a lower MIC value of 0.08 mg/ml (80 µg/ml), referring to a higher bacterial sensitivity. These differences could be related to variations in bioactive phytochemical materials. Furthermore, our study differed from the study of Rajendran and Rajeshkumar, that showed a clear indicator for AgNPs synthesized using cinnamon with 10 mm inhibition zone[20].

CONCLUSION

It was concluded that S.mutans infection can treat by small size nanomaterials of Ag with a clove extract, with minimal side effects on the body.

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Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Mushtaq Talip Hussein
Drafting or Revising Critically:	Mushtaq Talip Hussein
Final Approval of version:	The above author
Agreement to accountable for all aspects of work:	The above author

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Original Article

Depressive Symptoms and their Associated Factors among Physicians and Nurses in Military Healthcare Settings in Taif, Saudi Arabia

Tariq Hameed R Alotaibi[1], Nasser Awadh S Alshehri[2], Manal Saeed M Al Bogami[3], Maram Saeed M Al Bogami[4] and Shahad Eid Alotaibi[5]

ABSTRACT

Objective: This study aims to assess the prevalence of depression among healthcare workers, including physicians and nurses, and identify the factors contributing to its development

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the two military hospitals in Taif, Saudi Arabia: Al-Hada Armed Forces Hospital and Prince Mansour Community Military Hospital, from June 2024 to June 2025.

Methodology: The study was conducted to assess depression among healthcare workers in Taif, Saudi Arabia. The study included all physicians and nurses working at Al-Hada Armed Forces Hospital and Prince Mansour Community Military Hospital during the study period, provided they had worked there for at least six months.

Results: The sample consisted of 500 HCWs in the age range of 23-59 years. The study found that 64.8% of participants had depression, with 46.4% mild, 3.8% moderately severe, and 0.8% severe. Depression was more common in females (69.5%) than males (59.8%), with severe cases also higher in females (6.6% vs. 2.5%, p=0.036). Job-related factors played a key role, with head nurses (85.7%) and intern physicians (72.7%) having the highest depression rates, while physical therapists and nursing assistants had the lowest (38.5%). Depression was most prevalent among general surgeons and psychiatrists (80%) and least among radiologists (46.2%) and ICU workers (50%). Personal factors also contributed, as those who had lost a loved one in the past six months had significantly higher depression rates (71.8% vs. 64.2%, p<0.001).

Conclusion: The study highlights a high prevalence of depression among healthcare workers, with females, head nurses, and intern physicians at greater risk. Job role and workplace significantly influenced depression levels, with general surgeons, psychiatrists, and workers at Al-Hada Armed Forces Hospital experiencing higher rates.

Key Words: depression, health care workers, doctors, nurses, mental health, Taif

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INTRODUCTION

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Depression is one of the most prevalent mental health disorders worldwide and represents an important cause of psychological distress, functional impairment, reduced quality of life, and occupational disability. Depression can be described as a state of sadness, emotional distress, discouragement, hopelessness, irritability, lack of motivation, and a diminished interest or enjoyment in life.[1] The World Health Organization (WHO) in 2012 reported that depression is the main cause of disability for the population.[2] Many studies have reported on the prevalence and actual causes of depression in physicians and nurses.[3] A systematic review and meta-analysis that included studies from 15 countries estimated that the prevalence of depression among physicians ranged from 20.9% to 43.2%, with a pooled estimate of 28.8%.[4] In a systematic review and meta-analysis of studies conducted on intensive care unit nurses, the prevalence of depression was 12%.[5] According to WHO,

depression originates from a complex interaction of biological, psychological, and social factors. Gender differences are apparent regarding the prevalence of depression, with higher rates among women compared to men, due to factors associated with social responsibilities or hormonal imbalances associated with menstruation, menopause, and childbirth.[6]

Depression may impair job performance and productivity and increase employee turnover.[7] It could also negatively affect patient care. Healthcare workers are more prone to develop depression compared to others due to the stressful nature of their job.[8] The risk of psychological distress may differ between physicians and nurses because their occupational responsibilities and working environments are not identical.[9] Physicians frequently experience pressure related to diagnostic and therapeutic decision-making, prolonged duty hours, professional expectations, medico-legal concerns, and limited work–life balance.[10] Nurses, meanwhile, often have prolonged direct patient contact, rotating shifts, demanding bedside responsibilities, emotional interaction with patients and relatives, and exposure to workplace aggression. Night-shift work is particularly important among nursing professionals and has been significantly associated with depression, potentially through disruption of circadian rhythms, inadequate sleep, and chronic fatigue. More broadly, workplace bullying, violence, excessive job demands, inadequate resources, and poor social support have repeatedly emerged as potentially modifiable determinants of poor mental health among healthcare professionals.[11]

METHODOLOGY

A cross-sectional study was conducted to assess depression among healthcare workers in Taif, Saudi Arabia, at two military hospitals: Al-Hada Armed Forces Hospital (368 beds) and Prince Mansour Community Military Hospital (210 beds) from June 2024 to June 2025.

Data Collection: Data was collected using a self-administered questionnaire with three sections. The first gathered socio-demographic details and potential depression-related factors, including age, gender, marital status, nationality, job title, specialty, salary satisfaction, chronic illness, smoking, recent loss, BMI, work duration, night shifts, and family history of depression. The second section included the Patient Health Questionnaire-2 (PHQ-2) (Appendix 2), a preliminary depression screening tool with a sensitivity of 97% and specificity of 67%. The third section featured the Patient Health Questionnaire-9 (PHQ-9) (Appendix 3), used for screening, diagnosing, and assessing depression severity, with a sensitivity of 61% and specificity of 94%. A PHQ-2 score of ≥3 indicated possible depression, prompting PHQ-9 administration. The PHQ-9 score classified depression as follows: 0-4 (none), 5-9 (mild), 10-14 (moderate), 15-19 (moderately severe), and 20-27 (severe). Both tools are publicly available. The dependent variable in this study was depression among physicians or nurses. The independent variables included socio-demographic factors such as age, nationality, marital status, job title, specialty, and salary satisfaction. Work-related factors, including work duration, night shift status, and smoking status, were also considered. Additionally, health-related variables, such as chronic disease history, family history of depression, loss of a loved one in the past six months, and body mass index (BMI), were examined for their potential association with depression. A pilot study was conducted on approximately 10% of the sample to assess the clarity, format, and sequence of the questionnaire. Since no significant modifications were necessary, data from the pilot study were included in the final analysis.

Statistical Analysis: Data were entered into a personal computer and analyzed using SPSS version 25. Descriptive statistics, including mean, standard deviation, range, frequency, and percentage, were used to summarize data. Chi-square tests were performed to explore associations between depression severity and categorical variables. One-way ANOVA was used to compare means across multiple groups. Depression was treated as a dichotomous variable in multivariate logistic regression to identify significant predictors while controlling for confounders. Adjusted odds ratios (aOR) and 95% confidence intervals (CI) were reported, with statistical significance set at $p < 0.05$.

RESULTS

The study sample consists of a nearly equal gender distribution, with 48.2% males and 51.8% females. Participants' ages range from 23 to 59 years, with a mean age of 32.5 years and a standard deviation of 6.5 years, indicating some variation in age.

Table No. 1: Demographic characteristics of the participants (n=500)

Variable	Frequency (%) / Mean ± SD
Gender	
Male	241 (48.2)
Female	259 (51.8)
Age (years)	
Range	23–59
Mean ± SD	32.5 ± 6.5
Working place	
Al-Hada Military Hospital	318 (63.6)
Prince Mansour Military Hospital	182 (36.4)
Nationality	
Saudi	317 (63.4)
Non-Saudi	183 (36.6)
Marital status	
Single	162 (32.4)
Married	314 (62.8)
Divorced/Widowed	24 (4.8)

Job title	
Consultant physician	69 (13.8)
Senior specialist/Specialist physician	112 (22.4)
Resident physician	189 (37.8)
Intern	11 (2.2)
Head nurse	7 (1.4)
Registered nurse	99 (19.8)
Others	13 (2.6)
Years of work in the current facility (n = 461)	
<3 years	93 (20.2)
3–5 years	258 (55.9)
>5 years	110 (23.9)
Night shift work	
Yes	120 (24.0)
No	380 (76.0)
Specialty	
Internal Medicine	88 (17.6)
General Surgery	60 (12.0)
Orthopedics	28 (5.6)
Obstetrics & Gynaecology	67 (13.4)
Family Medicine	87 (17.4)
Pediatrics	59 (11.8)
Psychiatry	20 (4.0)
ICU	10 (2.0)
Emergency Department	25 (5.0)
Radiology	13 (2.6)
ENT	15 (3.0)
Others	28 (5.6)
Satisfaction with salary	
No	208 (41.6)
Yes	292 (58.4)

Regarding workplace distribution, 63.6% are recruited from Al-Hada Military Hospital, while 36.4% are from Prince Mansour Military Hospital. In terms of nationality, the majority, 63.4%, are Saudi nationals, whereas 36.6% are non-Saudi. Marital status data reveals that 32.4% are single, the majority, 62.8%, are married, and a smaller proportion, 4.8%, are divorced or widowed (Table 1). Depression severity was more prevalent among females than males (69.5% vs. 59.8%), with moderately severe/severe depression also being higher in females (6.6% vs. 2.5%). These differences were statistically significant (p=0.036). However, other demographic factors, including age, nationality, and marital status, showed no significant association with depression (Table 2).

A statistically significant association was observed between gender and depression severity (p = 0.036), with moderately severe/severe depressive symptoms being more common among females than males (6.6% vs. 2.5%), while absence of depression was more frequent among males (40.2% vs. 30.5%). Mean age did not differ significantly across depression categories, ranging from 31.0 ± 5.8 years in the moderately severe/severe group to 32.9 ± 7.1 years in the moderate group (p = 0.680). Workplace showed a significant association with depression severity (p = 0.001); participants from Al-Hada Military Hospital more frequently had mild depressive symptoms (51.6%), whereas a higher proportion of participants from Prince Mansour Military Hospital had no depression (46.7%) (Table 3).

Table No. 2: Association between participants` demographic characteristics and depression, based on PHQ-9 questionnaire

Variable	No depression, n = 176 n (%)	Mild, n = 232 n (%)	Moderate, n = 69 n (%)	Moderately severe/Severe, n = 23 n (%)	p-value
Gender					0.036*
Male (n = 241)	97 (40.2)	107 (44.4)	31 (12.9)	6 (2.5)	
Female (n = 259)	79 (30.5)	125 (48.3)	38 (14.7)	17 (6.6)	

*Statistically significant at $p < 0.05$.

Table No. 3: Association of sociodemographic characteristics with severity of depressive symptoms among study participants (n = 500)

Variable	No depression, n = 176	Mild, n = 232	Moderate, n = 69	Moderately severe/Severe, n = 23	p-value
Gender					0.036*
Male (n = 241)	97 (40.2)	107 (44.4)	31 (12.9)	6 (2.5)	
Female (n = 259)	79 (30.5)	125 (48.3)	38 (14.7)	17 (6.6)	
Age (years), Mean ± SD	32.6 ± 6.5	32.4 ± 6.5	32.9 ± 7.1	31.0 ± 5.8	0.680**
Working place					0.001*
Al-Hada Military Hospital (n = 318)	91 (28.6)	164 (51.6)	46 (14.5)	17 (5.3)	
Prince Mansour Military Hospital (n = 182)	85 (46.7)	68 (37.4)	23 (12.6)	6 (3.3)	
Nationality					0.558*
Saudi (n = 317)	115 (36.3)	147 (46.4)	39 (12.3)	16 (5.0)	
Non-Saudi (n = 183)	61 (33.3)	85 (46.4)	30 (16.4)	7 (3.8)	
Marital status					0.320*
Single (n = 162)	52 (32.1)	78 (48.1)	22 (13.6)	10 (6.2)	
Married (n = 314)	118 (37.6)	138 (43.9)	45 (14.3)	13 (4.1)	
Divorced/Widowed (n = 24)	6 (25.0)	16 (66.7)	2 (8.3)	0 (0.0)	

DISCUSSION

The present study demonstrated a substantial burden of depressive symptoms among physicians and nurses, with 64.8% of the 500 participants having some degree of depressive symptoms. Mild symptoms were the most frequent, affecting 46.4% of participants, followed by moderate symptoms in 13.8% and moderately severe/severe symptoms in 4.6%, while 35.2% had no depressive symptoms. These findings indicate that psychological distress is common among healthcare professionals, although most affected participants fell within the milder category. The high frequency of depressive symptoms is clinically important because persistent psychological distress among healthcare workers may adversely affect pe Depression leads to disability among HCWs, which leads to functional impairment in both their workplace and personal lives. This could result in deterioration in patient care. Few studies have been published about depression among hospital HCWs in Saudi Arabia. Therefore, this study was conducted to explore the prevalence and determinants of depression among HCWs (physicians and nurses) working at two main military hospitals in Taif governorate.[12]

In the present study, depression was reported among 31% of the healthcare workers, based on the PHQ-2 questionnaire, while according to the PHQ-9 questionnaire, depression was reported among 64.8% of them. It was mild in 46.4%, moderately severe, and severe among 3.8% and 0.8% of them, respectively. Variable results were reported elsewhere (locally and worldwide). The clearly observed discrepancy between the above-mentioned studies may be partly attributable to the different nature of the target population, different methodological approaches, and different tools used to diagnose depression. Therefore, a comparison between them is not practical.[13] Gender was significantly associated with the severity of depressive symptoms in the present study ($p = 0.036$). Although mild symptoms were common in both sexes, moderately severe/severe symptoms were more frequent among females than males (6.6% vs. 2.5%), whereas the proportion without depression was higher among males (40.2% vs. 30.5%).[14] This finding is consistent with evidence from Saudi healthcare settings suggesting greater psychological vulnerability among female healthcare professionals. The overall findings highlight that depressive symptoms among physicians and nurses are likely influenced by a combination of individual and occupational factors. Particularly noteworthy in the present study were the significant associations with gender and working place, whereas age, nationality, and marital status were not significantly related to symptom severity.[15,16] Previous research has similarly emphasized the importance of occupational environment, professional role, work experience, and workplace stress in determining the mental health of healthcare professionals.[17] In a Saudi armed-forces hospital study, depression affected 43.9% of healthcare workers and shorter professional experience was associated with greater risk, further supporting the importance of workplace-related determinants.[18] The present findings should be interpreted in light of certain limitations. The cross-sectional nature of the study prevents determination of temporal or causal relationships between associated factors and depressive symptoms. Self-reported assessment may also introduce reporting and response biases. Furthermore, the study was conducted in two healthcare facilities, which may limit generalizability to healthcare workers in other regions and institutions. Potentially important variables such as workload, weekly working hours, sleep quality, burnout, workplace violence, social support, previous psychiatric illness, and recent stressful life events may also influence depressive symptoms and should be considered in future studies. Prospective multicenter investigations incorporating occupational and psychosocial variables and multivariable regression analysis would provide a more comprehensive understanding of independent predictors of depression among physicians and nurses.

CONCLUSION

It is concluded that depressive symptoms were common among physicians and nurses, with nearly two-thirds of participants experiencing some degree of depression, predominantly mild symptoms. Female gender and working place were significantly associated with the severity of depressive symptoms, whereas age, nationality, and marital status showed no significant association. These findings highlight the need for routine mental health screening, confidential psychological support, and workplace-based interventions aimed at reducing occupational stress among healthcare professionals. Further multicenter prospective studies are recommended to identify independent predictors and modifiable workplace factors contributing to depression in this population.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Tariq Hameed R Alotaibi, Nasser Awadh S Alshehri
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Agreement to accountable for all aspects of work:	All the above authors

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Original Article

Effect of Simulated Mouth Breathing on Emergence Agitation After Nasal Surgeries

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ABSTRACT

Objective: To evaluate the effectiveness of preoperative simulated mouth-breathing training in reducing the severity and incidence of emergence agitation among adult patients undergoing nasal surgery under general anesthesia

Study Design: Randomized controlled trial study

Place and Duration of Study: This study was conducted at the Department of Anesthesiology and Pain Medicine, Shifa International Hospital, Islamabad, from 1st October 2025 till 31st March 2026.

Methodology: The trial included 180 adults aged 18–65 years with ASA physical status I–II undergoing sinonasal surgery with nasal packing. Ninety patients received simulated mouth-breathing training at three preoperative time points and 90 received standard preoperative care. Richmond Agitation-Sedation Scale (RASS) scores were recorded at extubation and 15 and 30 minutes later.

Results: Mean RASS scores were lower with mouth-breathing training at extubation (1.02±0.85 vs 1.32±0.99), 15 minutes (0.99±0.99 vs 1.37±1.15), and 30 minutes (0.66±0.77 vs 1.04±0.95). The overall mixed-model treatment effect was −0.36 RASS points (95% CI −0.56 to −0.15; p<0.001), with no treatment-by-time interaction (p=0.845). EA at 15 and 30 minutes was less frequent in the intervention group. However, the proportion experiencing at least one EA episode during the full 30-minute period was 51.1% versus 61.1% (RR 0.84, 95% CI 0.64–1.09; p=0.176).

Conclusion: Preoperative simulated mouth-breathing training reduced the severity of emergence agitation and the repeated probability of agitation during early recovery. It did not significantly reduce the proportion of patients who experienced at least one EA episode.

Key Words: emergence agitation; mouth breathing; sinonasal surgery; RASS; preoperative education.

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INTRODUCTION

During recovery from general anaesthesia, some adults develop a short period of restlessness, disorientation, or non-purposeful movement.[1] This is commonly described as emergence agitation (EA).[2] Reported rates vary considerably because studies use different populations, observation windows, and diagnostic thresholds.[3] Although often brief, EA can disrupt recovery and may result in self-injury, removal of lines or tubes, bleeding, greater staff workload, and other postoperative problems.[4] The issue is especially relevant in nasal and other ENT procedures.[5] Several factors may contribute, including pain, younger age, smoking, airway instrumentation, and volatile anesthesia.[6] Nasal packing adds another feature that is specific to these operations: the patient wakes unable to breathe normally through the nose and must immediately switch to oral breathing. While still emerging from anaesthesia, that unfamiliar sensation may be interpreted as obstruction or suffocation.[7,8]

Preventive strategies therefore span more than one approach. Dexmedetomidine, butorphanol, propofol-based total intravenous anaesthesia, and deep extubation have all been studied as ways of reducing EA.[9] Non-pharmacological methods are attractive for a different reason: they do not add sedative or haemodynamic effects. Previous studies have explored nasal compression, nasal splinting, and preoperative familiarization with mouth breathing.[10,11]

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METHODOLOGY

This randomized controlled trial was conducted in the Department of Anaesthesiology and Pain Medicine, Shifa International Hospital, Islamabad from 1st October 2025 till 31st March 2026. A total of 180 patients were enrolled using non-probability consecutive sampling and randomly allocated into two equal groups through the lottery method. Group A comprised 90 patients who received preoperative simulated mouth-breathing training, while Group B included 90 patients who received standard preoperative care. Patients aged 18–65 years, of either sex, with American Society of Anesthesiologists (ASA) physical status I or II, who were scheduled to undergo sinonasal surgery under general anesthesia with planned postoperative nasal packing, were included. Eligible surgical procedures included septoplasty, septorhinoplasty, turbinate reduction, and functional endoscopic sinus surgery (FESS). Patients with pre-existing psychiatric or neurological disorders, those receiving psychotropic medications, and patients unable to understand Urdu, Pashto, Punjabi, or English were excluded. Patients with ASA physical status III or higher, those undergoing procedures without postoperative nasal packing, and individuals who declined informed consent were also excluded.

Data Collection: Following institutional ethical approval, eligible patients were assessed according to the predefined inclusion and exclusion criteria. Written informed consent was obtained before enrollment. Participants were randomly allocated in a 1:1 ratio to the intervention or control group using the lottery method. Both groups received routine preoperative counseling regarding anesthesia, surgical procedures, and perioperative care. In addition to standard counseling, patients in Group A underwent simulated mouth-breathing training at three predefined intervals: during the pre-anesthesia assessment clinic visit, on the night before surgery, and during transfer to the operating room. During each training session, nasal airflow was temporarily obstructed using a swimmer's nasal clip, and patients were instructed to breathe through the mouth to become familiar with the sensation of nasal obstruction. Patients in Group B received standard preoperative care without simulated nasal obstruction or mouth-breathing training. A standardized general anesthesia protocol was followed for all participants. Routine intraoperative monitoring included electrocardiography, non-invasive blood pressure measurement, and pulse oximetry. Anesthesia was induced using intravenous midazolam 1.5 mg, nalbuphine 0.1 mg/kg, atracurium 0.6 mg/kg, and propofol 2 mg/kg, followed by endotracheal intubation. Anesthesia was maintained using sevoflurane at approximately 1.8% volume, with supplemental atracurium 0.1 mg/kg administered as required. Intravenous paracetamol was administered for perioperative analgesia at a dose of 1 g in patients weighing more than 50 kg and 15 mg/kg in those weighing less than 50 kg. At the completion of surgery, neuromuscular blockade was reversed using neostigmine and glycopyrrolate under train-of-four monitoring. Endotracheal extubation was performed after fulfillment of predefined clinical recovery criteria.

Assessment of Emergence Agitation: Emergence agitation was assessed using the Richmond Agitation-Sedation Scale (RASS). Scores were recorded immediately after extubation and subsequently at 15 and 30 minutes during early postoperative recovery. The primary outcome was the severity of emergence agitation, assessed through RASS scores across the three measurement intervals. Emergence agitation was operationally defined as a RASS score of $\geq+2$. Secondary outcomes included the proportion of patients developing emergence agitation at each assessment, the proportion experiencing at least one episode of agitation during the 30-minute observation period, the requirement for clinical intervention, and the duration of stay in the post-anesthesia care unit (PACU).

Statistical Analysis: Data were analyzed using Python version 3.13 with the pandas, SciPy, and statsmodels libraries. Continuous variables with approximately symmetric distributions were expressed as mean ± standard deviation, while skewed variables were presented as median with interquartile range (IQR). Between-group comparisons of normally distributed continuous variables were performed using the independent-samples t-test, whereas the Mann–Whitney U test was applied to skewed variables. Repeated binary emergence-agitation outcomes were analyzed using generalized estimating equations (GEE) with a modified Poisson model and robust standard errors. Treatment effects were expressed as risk ratios with 95% confidence intervals. The proportion of patients experiencing at least one agitation episode during the 30-minute observation period was analyzed separately at the patient level. All statistical tests were two-sided, and a p-value ≤ 0.05 was considered statistically significant.

RESULTS

All 180 randomized patients were included in the final analysis, with 90 patients in each group. RASS data were complete at all three assessment times. Age, sex, BMI, ASA physical status, and overall comorbidity burden were similar between groups. FESS was more frequent in the control group (62.2% vs 45.6%; Pearson chi-square p=0.025). Surgery duration also tended to be longer in controls, with a median of 140.5 minutes (IQR 91.0-165.8) compared with 123.0 minutes (IQR 80.3-143.8) in the intervention group (Mann-Whitney U p=0.057; standardized mean difference approximately 0.32) (Table 1).

RASS scores were lower in the mouth-breathing group at each scheduled assessment. At extubation the mean score was 1.02±0.85 compared with 1.32±0.99 in controls. The difference remained present at 15 minutes and 30 minutes. In the random-intercept mixed model, the average treatment effect across the three assessments was −0.36 RASS points (95% CI −0.56 to −0.15; p<0.001) (Table 2, Fig 1).

The primary finding was robust to alternative analysis. Gaussian GEE gave an almost identical treatment estimate (mean difference −0.36, 95% CI −0.56 to −0.15; p<0.001). When RASS was treated as an ordinal outcome, the odds of occupying a higher RASS category were also lower with training (OR 0.49, 95% CI 0.33–0.74; p<0.001). Adjustment for FESS and duration of surgery produced a similar mixed-model effect (adjusted mean difference −0.32, 95% CI −0.52 to −0.11; p=0.003).

EA defined as RASS ≥+2 occurred less often in the intervention group at each time point. The difference was not statistically significant at extubation, but was significant at 15 and 30 minutes. When EA was summarized as whether a patient experienced at least one episode during the entire observation period, 46/90 (51.1%) intervention patients and 55/90 (61.1%) controls met the definition (RR 0.84, 95% CI 0.64–1.09; p=0.176) (Table 3, Fig 2).

Table No. 1: Baseline demographic and perioperative characteristics

Characteristic	Mouth-breathing training (n=90)	Control (n=90)	p-value
Age, years	34.5 ± 12.4	35.6 ± 12.3	0.571
Male sex, n (%)	60 (66.7)	56 (62.2)	0.533
BMI, kg/m²	26.5 ± 5.3	26.8 ± 4.9	0.705
ASA II, n (%)	44 (48.9)	49 (54.4)	0.456
Any recorded comorbidity, n (%)	45 (50.0)	47 (52.2)	0.766
FESS included, n (%)	41 (45.6)	56 (62.2)	0.025
Septoplasty included, n (%)	67 (74.4)	72 (80.0)	0.374
Turbinate reduction, n (%)	60 (66.7)	57 (63.3)	0.639
Duration of surgery, min, median (IQR)	123.0 (80.3-143.8)	140.5 (91.0-165.8)	0.057

Table No. 2: RASS scores and treatment effects

Assessment	Mouth-breathing training	Control	Mean difference (95% CI)	Hedges g	p-value
Extubation	1.02 ± 0.85	1.32 ± 0.99	−0.30 (−0.58 to −0.02)	−0.32	0.035
15 minutes	0.99 ± 0.99	1.37 ± 1.15	−0.38 (−0.66 to −0.10)	−0.35	0.008
30 minutes	0.66 ± 0.77	1.04 ± 0.95	−0.39 (−0.67 to −0.11)	−0.45	0.006
Overall mixed-model effect	—	—	−0.36 (−0.56 to −0.15)	—	<0.001

Table No. 3: Emergence agitation, intervention requirement and PACU duration

Outcome	Mouth-breathing training	Control	Effect estimate (95% CI)	p-value
EA at extubation	27/90 (30.0%)	38/90 (42.2%)	RR 0.71 (0.48–1.06)	0.088
EA at 15 minutes	21/90 (23.3%)	36/90 (40.0%)	RR 0.58 (0.37–0.92)	0.016
EA at 30 minutes	14/90 (15.6%)	26/90 (28.9%)	RR 0.54 (0.30–0.96)	0.031
Any EA, 0–30 min	46/90 (51.1%)	55/90 (61.1%)	RR 0.84 (0.64–1.09)	0.176
Recorded intervention	6/90 (6.7%)	14/90 (15.6%)	RR 0.43 (0.17–1.07)	0.058
PACU duration, min, median (IQR)	35 (30–40)	35 (35–40)	—	0.142

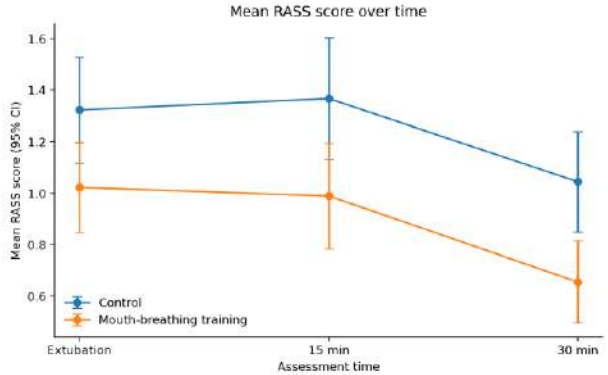


Figure No. 1: Mean RASS score at extubation, 15 minutes, and 30 minutes. Error bars represent 95% confidence intervals.

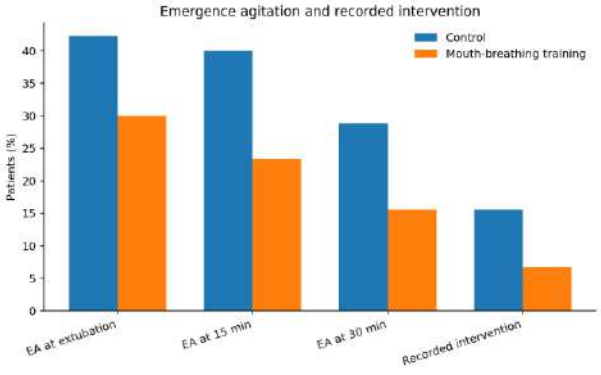


Figure No. 2: Proportion of patients meeting RASS ≥+2 at each assessment and proportion with a recorded intervention.

DISCUSSION

The present randomized controlled trial evaluated the effectiveness of preoperative simulated mouth-breathing training in reducing emergence agitation among adult patients undergoing sinonasal surgery under general anesthesia. The findings demonstrated that patients receiving simulated mouth-breathing training had significantly lower Richmond Agitation-Sedation Scale (RASS) scores during the first 30 minutes following extubation compared with those receiving standard preoperative care. The overall treatment effect was significant, indicating that preoperative familiarization with mouth breathing may reduce the severity of emergence agitation. However, although the frequency of agitation was lower at individual postoperative assessments, the proportion of patients experiencing at least one episode during the observation period did not differ significantly between the groups. This pattern is compatible with the earlier randomized study by Xu et al[10], which combined nasal splinting with mouth-breathing training and reported emergence delirium in 16.3% of the intervention group compared with 35.6% of controls after endoscopic sinus surgery. The absolute rates are not directly transferable because the intervention and agitation scale were different. Even so, the direction of effect is similar. Kumari and Agrawal[11] also reported benefit from preoperative external nasal compression, and a network meta-analysis of 17 randomized trials involving 2,122 patients found that both pharmacological and non-pharmacological strategies can reduce EA after nasal surgery.[12] The common thread across these approaches may be preparation for the sensation of postoperative nasal blockage.

The cumulative frequency of EA in our cohort was high, but this should be interpreted alongside the way the outcome was measured. Adult studies report widely different rates depending on the scale, threshold, and duration of observation, while nasal and ENT procedures are consistently represented among higher-risk groups.[3-8] Kim et al. reported 22.2% after nasal surgery using a lower threshold of RASS $\geq$+1 and identified younger age, recent smoking, sevoflurane, postoperative pain, and airway or urinary devices as risk factors.[13] We used RASS $\geq$+2 but observed patients on three occasions over 30 minutes. A cumulative endpoint that counts an episode at any of those assessments will naturally be higher than a single-time-point estimate. Pharmacological prophylaxis remains an important comparator. Dexmedetomidine has been studied extensively in nasal surgery: one randomized trial reduced agitation from 52% to 28% with intraoperative infusion, and a 2025 meta-analysis of nine trials also found a protective effect.[14] Preoperative intranasal dexmedetomidine has shown similar benefit in adult ENT surgery.[15] Butorphanol has also reduced EA after FESS, although delayed spontaneous breathing, verbal response, and extubation were reported.[16] These options may produce stronger binary effects than a behavioral intervention, but they also introduce drug-related consequences. Simulated mouth-breathing training is better viewed as an additional low-risk measure, not as a substitute for pharmacological treatment when that is otherwise indicated. The background anaesthetic technique is another relevant factor. Propofol-based total intravenous anaesthesia has produced less emergence agitation than volatile maintenance after nasal surgery[17], a finding supported by meta-analysis.[18] Deep extubation has also been associated with less EA than awake extubation in a recent randomized trial.[19] Our protocol used sevoflurane in both groups. This standardization strengthens the internal group comparison, but it may also have raised the overall frequency of agitation and limits direct extrapolation to pathways based on TIVA or different extubation strategies. An important practical implication of the study is the feasibility of implementing simulated mouth-breathing training in routine preoperative care. The intervention required only a swimmer's nasal clip, brief instructional sessions, and patient cooperation. It was administered at three preoperative time points without additional pharmacological treatment. In resource-limited healthcare settings, including many hospitals in Pakistan, inexpensive interventions that improve the quality of postoperative recovery may be particularly valuable. Preoperative education can be integrated into anesthesia assessment and nursing counseling without requiring specialized equipment or major changes to surgical protocols.

This study had several limitations. First, it was conducted at a single tertiary-care hospital with a sample size of 180 patients, which may limit the generalizability of the findings to other healthcare settings and surgical populations. Second, the study included only adults with ASA physical status I–II undergoing sinonasal surgery with postoperative nasal packing; therefore, the findings may not be applicable to patients with more severe systemic diseases or those undergoing procedures without nasal packing. Third, although randomization was performed, functional endoscopic sinus surgery was more frequent in the control group, and surgical duration tended to be longer, potentially influencing postoperative agitation despite statistical adjustment. Fourth, emergence agitation was assessed using the Richmond Agitation-Sedation Scale, which measures agitation and sedation but does not specifically distinguish emergence delirium from agitation caused by pain, anxiety, or respiratory discomfort. Larger multicenter randomized trials with standardized assessments of pain, anxiety, postoperative complications, and longer follow-up are recommended to confirm these findings.

CONCLUSION

Preoperative simulated mouth-breathing training was associated with lower RASS scores during the first 30 minutes after sinonasal surgery and with less agitation across repeated assessments. It did not demonstrate a

statistically significant reduction in the proportion of patients who experienced at least one RASS ≥+2 episode. As a brief, low-cost intervention without additional drug exposure, it may be a useful adjunct for improving the quality of emergence after nasal surgery.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Saad Rasool, Muhammad Hussan Farooq
Drafting or Revising Critically:	Saad Rasool, Sana Mustafa
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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Original Article

The Impact of Burnout among Occupational Therapists on Patient Satisfaction at King Abdulaziz Medical City: A Cross-Sectional Study

Zamil Alsubaie[1] and Shakir Saleem[2]

ABSTRACT

Objective: This study aimed to examine the association between burnout among occupational therapists and patient satisfaction at King Abdulaziz Medical City, Riyadh.

Study Design: A cross-sectional correlational study

Place and Duration of Study: This study was conducted at the at King Abdulaziz Medical City, Saudi Arabia from 20 March 2025 to 20 May 2025

Methodology: This study was conducted among 16 occupational therapists and 160 patients at King Abdulaziz Medical City. Therapist burnout was assessed using the Burnout Assessment Tool (BAT), while patient satisfaction was evaluated using Monnin and Perneger's patient satisfaction questionnaire.

Results: A statistically significant negative correlation was observed between occupational therapist burnout and patient satisfaction ($r = -0.63$, $p = 0.009$), indicating that higher burnout levels were associated with lower patient satisfaction. Overall, 68.75% of occupational therapists reported high or very high levels of burnout, with a mean BAT score of 3.42 ± 1.12. Despite the high prevalence of burnout, overall patient satisfaction remained high, with a mean score of 4.62 ± 0.31. Patient satisfaction scores were significantly lower among patients treated by therapists with very high burnout compared with those treated by therapists with average or high burnout levels.

Conclusion: Higher levels of burnout among occupational therapists were significantly associated with lower patient satisfaction. Although overall patient satisfaction remained high, the findings suggest that severe therapist burnout may negatively influence patients' experiences of care. Organizational strategies aimed at reducing occupational burnout and supporting therapist well-being may therefore contribute to maintaining and improving patient-centered rehabilitation services.

Key Words: Burnout, Occupational therapists, Patient satisfaction, healthcare, healthcare professionals

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INTRODUCTION

Burnout has emerged as one of the most pressing occupational hazards affecting healthcare professionals globally. Defined by the World Health Organization (WHO) in the ICD-11 as a syndrome resulting from chronic workplace stress that has not been successfully managed, burnout has shifted from being perceived as an individual concern to a critical organizational and systemic issue[1]. Healthcare systems are particularly vulnerable due to their high-pressure environments, complex care demands, and emotional labor. Studies have shown that burnout prevalence among healthcare workers, including physicians, nurses, and therapists, is significantly higher than in the general workforce[2]. Emotional exhaustion refers to feelings of being overextended and depleted, while depersonalization involves developing cynicism toward patients, and diminished personal accomplishment pertains to a perceived lack of professional efficacy. Recent developments in burnout theory, such as the job demands-resources (JD-R) model, offer a broader

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perspective. The JD-R framework postulates that burnout arises when job demands exceed the personal and organizational resources available to cope with those demands[3]. Among the various healthcare professionals, occupational therapists (OTs) are uniquely positioned in the rehabilitation continuum, managing complex patient needs across physical, cognitive, and psychosocial domains. Their work often requires intensive, long-term engagement with patients facing life-altering conditions, demanding both technical expertise and deep emotional investment[4]. Internationally, burnout among occupational therapists has been linked to high administrative burdens, evolving expectations for productivity, and emotional labor intrinsic to therapeutic relationships[5]. This trend is not isolated. A study noted that burnout increases with professional longevity, underscoring its cumulative nature. Furthermore, contemporary healthcare is undergoing rapid technological and organizational transformations, many of which impose new pressures on the workforce[6]. The COVID-19 pandemic dramatically exacerbated existing stressors. From a workforce sustainability perspective, retaining skilled occupational therapists is crucial for a functional and resilient rehabilitation system[7]. Identifying and mitigating burnout risks can reduce early career exits and enhance job satisfaction, thereby strengthening the healthcare workforce. Finally, the research has educational implications[8-10]. The findings can inform occupational therapy training programs to integrate burnout prevention, emotional regulation, and resilience-building strategies into curricula. This can better prepare future therapists to navigate the complex emotional and cognitive demands of their roles.

METHODOLOGY

A cross-sectional correlational study was conducted at King Abdulaziz Medical City (KAMC), Riyadh, from 20 March 2025 to 20 May 2025. The study was designed to assess the association between burnout among occupational therapists and patient satisfaction without manipulating any study variables. The study population consisted of occupational therapists working at KAMC and patients receiving occupational therapy services. Census sampling was used for occupational therapists because of the small number of eligible therapists. All 16 eligible occupational therapists were included in the study. For patients, convenience sampling was used, and 160 patients were recruited, with 10 patients linked to each participating therapist. Occupational therapists were eligible if they were licensed, currently employed at KAMC, had worked at the institution for at least six months, provided direct patient care for at least 20 hours per week, and agreed to participate and complete the burnout assessment. Patients were included if they were aged 18 years or older, had received at least three occupational therapy sessions from a participating therapist, were cognitively able to complete the questionnaire independently or with minimal assistance, were not experiencing acute psychological distress, and provided informed consent.

Data Collection and Matching: Eligible therapists were invited through departmental emails and staff meetings, while patients were identified through scheduling records and approached during therapy sessions or follow-up visits. A confidential coding system was used to link each patient's satisfaction score with the occupational therapist who provided their care. This allowed therapist burnout scores to be directly correlated with the satisfaction scores of their respective patients while maintaining confidentiality. Burnout among occupational therapists was assessed using the 23-item Burnout Assessment Tool (BAT) developed by Schaufeli et al. The tool measures four dimensions: exhaustion, mental distance, cognitive impairment, and emotional impairment. Therapists completed the questionnaire electronically through Microsoft Forms using a 5-point Likert scale ranging from 1 = never to 5 = always. Mean scores were calculated for each domain and an overall burnout score was obtained by averaging all 23 items. Scores were categorized as very low, low, average, high, and very high burnout. The BAT has demonstrated strong internal consistency, with Cronbach's alpha values ranging from 0.86 to 0.92 for individual subscales and 0.95 for the overall scale. Patient satisfaction was measured using the 14-item Monnin and Perneger patient satisfaction questionnaire. The instrument evaluates four domains: treatment satisfaction, admission process, logistics, and global assessment. Patients completed the questionnaire through Microsoft Forms using a 5-point response scale, scored from 1 = poor to 5 = excellent. Mean domain scores and an overall satisfaction score were calculated, with higher scores indicating greater satisfaction. The instrument has demonstrated good internal consistency, with a Cronbach's alpha of 0.91 for the overall scale and values ranging from 0.77 to 0.90 for its subscales.

Statistical Analysis: Data were analyzed using IBM SPSS Statistics version 26. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to summarize demographic characteristics, burnout levels, and patient satisfaction scores. Pearson's correlation coefficient was used to assess the association between therapist burnout and patient satisfaction. One-way ANOVA followed by Tukey's post-hoc test was used to compare patient satisfaction scores across different burnout categories. Independent-samples t-tests and ANOVA were also used to assess differences according to demographic characteristics. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 16 occupational therapists and 160 patients were included in the study. The key findings are summarized below.

Table No.1: Demographic Characteristics of Study Participants

Characteristic	Occupational Therapists (n = 16)	Patients (n = 160)
Age, years, Mean ± SD	30.63 ± 4.21	52.1 ± 14.2
Male, n (%)	9 (56.25%)	83 (52.0%)
Female, n (%)	7 (43.75%)	77 (48.0%)
Bachelor's degree, n (%)	9 (56.25%)	54 (33.7%)
Master's degree, n (%)	6 (37.50%)	8 (5.0%)
Professional experience, years, Mean ± SD	6.19 ± 2.97	—

The mean age of occupational therapists was 30.63 ± 4.21 years, with mean professional experience of 6.19 ± 2.97 years. Among therapists, 56.25% were male and 43.75% were female. Patients had a mean age of 52.1 ± 14.2 years, with 52.0% males and 48.0% females.

Table No.2: Distribution of Burnout Levels Among Occupational Therapists

Burnout Level	n	%
Very high	9	56.25
High	2	12.50
Average	5	31.25
Low/Very low	0	0.00

Burnout was common among the participating therapists. Overall, 68.75% had high or very high burnout: 56.25% were in the very high category, 12.50% in the high category, and 31.25% had average burnout. None had low or very low burnout.

Table No.3: Patient Satisfaction Scores by Domain

Satisfaction Domain	Mean ± SD
Treatment satisfaction	4.78 ± 0.24
Admission process	4.52 ± 0.36
Logistics	4.41 ± 0.42
Global assessment	4.76 ± 0.26
Overall satisfaction	4.62 ± 0.31

Overall patient satisfaction was high (4.62 ± 0.31 out of 5). Treatment satisfaction had the highest mean score (4.78 ± 0.24), followed by global assessment (4.76 ± 0.26), admission process (4.52 ± 0.36), and logistics (4.41 ± 0.42).

Table No.4: Correlation Between Therapist Burnout and Patient Satisfaction

Burnout Measure	Correlation Coefficient (r)	p-value
Overall burnout	−0.63	0.009
Exhaustion	−0.58	0.018
Mental distance	−0.52	0.039
Cognitive impairment	−0.49	0.054
Emotional impairment	−0.41	0.114

Overall burnout was significantly and negatively correlated with patient satisfaction ($r = -0.63$, $p = 0.009$). Exhaustion ($r = -0.58$, $p = 0.018$) and mental distance ($r = -0.52$, $p = 0.039$) were also significantly associated with lower satisfaction. Cognitive and emotional impairment showed negative but non-significant associations.

DISCUSSION

This study investigated the relationship between burnout among occupational therapists and patient satisfaction at King Abdulaziz Medical City. The results revealed a significant negative correlation between therapist burnout and patient satisfaction, providing important insights into how healthcare provider well-being impacts service quality and patient experiences. A concerning finding from this study is the high prevalence of burnout among occupational therapists at King Abdulaziz Medical City, with 68.75% of therapists experiencing high or very high burnout levels. This rate exceeds those reported in previous studies of healthcare professionals in Saudi Arabia, such as the 36% high emotional exhaustion reported by many studies[11,12].

The high burnout rates identified in this study may be attributed to several factors specific to occupational therapy practice. Occupational therapists often work with patients who have complex needs requiring prolonged, intensive, and emotionally demanding interactions. In the context of King Abdulaziz Medical City, where most therapists in this study worked in inpatient settings (81.25%), the continuous exposure to patients with severe conditions likely contributes to emotional exhaustion and burnout. Additionally, administrative burdens, including documentation requirements, limited resources, and high caseloads likely contribute to the elevated burnout levels observed[13]. In the Saudi healthcare context, these factors may be amplified by cultural expectations, organizational structures, and the rapid evolution of healthcare systems that has characterized the Kingdom's recent healthcare development. Despite the high burnout rates among therapists, overall patient satisfaction with occupational therapy services was remarkably high (mean score 4.62 out of 5)[14]. This

seemingly paradoxical finding suggests that therapists may be maintaining professional standards and quality of care despite their personal experiences of burnout. Similar findings were reported by Tariah et al. (2022), who found that occupational therapists in Riyadh maintained professional commitment despite challenges with certain job aspects[15].

The highest satisfaction domain was treatment satisfaction (mean 4.78), which encompasses therapist competence, communication, and treatment efficacy. This suggests that patients particularly value direct therapeutic interactions and perceive this as high quality. The strong ratings for therapist reassurance abilities (mean 4.89) and information about future treatment plans (mean 4.84) indicate that therapists are especially effective in providing emotional support and clear communication about treatment progression. The significant negative correlation ($r = -0.63$, $p = 0.009$) between therapist burnout and patient satisfaction provides empirical evidence that therapist well-being directly impacts patient care experiences[16]. This pattern aligns with the theoretical understanding of burnout, particularly the components of emotional exhaustion and depersonalization. When therapists experience emotional exhaustion, they have fewer psychological resources available for empathetic engagement and emotional support of patients. Similarly, depersonalization (reflected in the mental distance component of the BAT) involves psychological withdrawal and reduced emotional involvement, directly impacting interpersonal connection with patients[17]. The findings of this study must be interpreted within the cultural context of Saudi Arabia, which influences both healthcare delivery and patient expectations. Saudi Arabian culture places high value on personal relationships, respect for authority figures (including healthcare providers), and collectivist approaches to healthcare decision-making[18-20]. These cultural factors may shape how burnout manifests among therapists and how patients evaluate their care experiences. This study has several limitations that should be considered when interpreting the findings. First, it was conducted at a single tertiary healthcare institution in Saudi Arabia, which may limit the generalizability of results to other settings with different organizational structures, resources, and patient populations. Expanding future research to multiple centers would improve external validity. Second, the high patient satisfaction scores may be influenced by response bias, including social desirability and cultural tendencies toward positive evaluations of healthcare providers.

CONCLUSION

This study provides empirical evidence of a significant negative relationship between occupational therapist burnout and patient satisfaction at King Abdulaziz Medical City. Although patient satisfaction remained generally high, therapists experiencing burnout showed reduced capacity to deliver optimal care, particularly in communication and emotional support. The finding that 68.75% of therapists experienced high or very high burnout levels highlights an urgent occupational health concern. A strong negative correlation ($r = -0.63$, $p = 0.009$) confirmed that therapist well-being directly affects patient experiences, particularly in interpersonal aspects of care. A threshold effect was observed, where patient satisfaction declined markedly only when burnout reached very high levels, suggesting that therapists can initially compensate for burnout until it becomes severe.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Zamil Alsubaie, Shakir Saleem
Drafting or Revising Critically:	Zamil Alsubaie, Shakir Saleem
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

Conflict of Interest: The study has no conflict of interest to declare by any author.

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Original Article

Neuroprotective Effects of PLCL Galantamine Nanoparticles Via PIK3CA Pathway Activation in Aluminum Chloride Induced Neurotoxicity Model

Luma Ali Mahmoud[1], Rana Ayad Ghaleb[3] and Aymen A. Bash[2]

ABSTRACT

Objective: To analyze theneuroprotective efficacy of galantamine encapsulated in poly(lactide-co-ε-caprolactone) nanoparticles against aluminum chloride induced neurotoxicity.

Study Design: Experimental study

Place and Duration of Study: This study was conducted at the College of Medicine, University of Babylon, Iraq from 1st December 2025 to 30th March 2026.

Methodology: SH-SY5Y cell lines were treated with poly(lactide-co-ε-caprolactone) galantamine nanoparticles at concentrations of 6.25, 25, and 100 µg/mL, either alone or in combination with aluminum chloride (500 µg/mL) along with untreated cells as a control group.

Results: Aluminum chloride (500 µg/mL) reduced cell viability to 65% and establishing a cytotoxic baseline, poly(lactide-co-ε-caprolactone)-galantamine nanoparticles administered 24 hours before aluminum chloride challenge restored viability to 101-116% across all concentrations tested, and produced a striking 8.49-fold phosphatidylinositol-4,5-bisphosphate 3-kinase catalytic subunit alpha upregulation at 6.25 µg/mL,

Conclusion: Poly(lactide-co-ε-caprolactone) nanoparticles significantly enhance the neuroprotective effect of galantamine on aluminum chloride induce toxicity in SH-SY5Y cell line by activation the survival pathways.

Key Words: Alzheimer's disease, Poly(lactide-co-ε-caprolactone)-galantamine nanoparticles, Aluminium chloride

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INTRODUCTION

Alzheimer's disease (AD) is the most known cause of dementia and is characterized by the build of aggregates in the brain known as amyloid plaques and tangles of tau protein.[1] Currently, existing medications largely provide symptomatic relief with limited effects on disease progression.[2]

Galantamine, an acetylcholinesterase inhibitor (AChEI), is widely used in the management of AD because it enhances cholinergic neurotransmission and improves cognitive function. Beyond its symptomatic effects, galantamine exhibits neuroprotective properties by modulating nicotinic acetylcholine receptors (nAChRs), particularly the α7 subtype. Activating these receptors lowers neuroinflammation by inhibiting NF-κBsignaling and pro-inflammatory cytokine production while increasing cell-survival pathways such as PI3K/Akt and Bcl-2 signaling.[3,4] However, the clinical utility of galantamine is limited by its relatively short half-life, poor lipophilicity, frequent dosing requirements, and peripheral cholinergic adverse effects, which may reduce treatment compliance.[5,6]

Nanotechnology-based drug delivery systems have attracted considerable attention for improving the therapeutic performance of neuroactive agents. Nanoparticles can enhance drug stability, bioavailability, and cellular uptake while enabling controlled drug release. Among these systems, polymeric nanoparticles are particularly attractive because of their biocompatibility and ability to minimize drug-related toxicity.[7,8]

Poly(lactide-co-ε-caprolactone) [PLCL] is a biodegradable and biocompatible polymer with favorable properties for neural drug delivery. Its degradation rate can be tailored by modifying its composition, allowing sustained drug release and prolonged therapeutic activity. Encapsulation of galantamine within PLCL nanoparticles may improve drug stability, maintain effective intracellular concentrations, and enhance neuroprotective efficacy.[9]

Aluminum exposure has been associated with cognitive dysfunction and neurodegenerative changes. Experimental studies suggest that aluminium inhibits the PI3K/Akt/mTOR signaling pathway, a crucial regulator of neuronal survival, development, and

metabolism, therefore leading to neuronal damage and disease progression.[10]

Despite the potential advantages of PLCL-based galantamine delivery, its protective effects against aluminum-induced neurotoxicity remain insufficiently explored. Therefore, The current study investigated the neuroprotectiveeffect of galantamine-loaded PLCL nanoparticles against $AlCl_3$-induced toxicity in SH-SY5Y human neuroblastoma cells, with particular emphasis on modulation of PIK3CA gene expression.

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METHODOLOGY

This experimental study was onducted at College of Medicine, University of Babylon, Iraq from 1st December 2025 to 30th Mary 2026 letter No.4-50 dated 6-11-2025. The SH-SY5Y human neuroblastoma cell line was acquired from Iran's National Cell Bank. Cells were grown in RPMI-1640 media supplemented with 10% FBS and antibiotics and maintained at 37°C in a humidified incubator with 5% CO_2. For cytotoxicity experiments, cells were seeded into 96-well plates with a density of 5×10^3 cells per well.

Aluminum chloride ($AlCl_3$) was purchased from THOMAS BAKER L.T.D. (India), while galantamine powder was obtained from China. MTT reagent was purchased from Roth (Germany), and RPMI-1640 medium was supplied by Capricorn Scientific (Germany). A stock solution of $AlCl_3$ (500 µg/mL) was prepared in serum-free RPMI medium, sterilized with a 0.22 µm membrane filter, and stored under sterile conditions for usage. Galantamine-loaded PLCL nanoparticles were prepared using the nanoprecipitation technique. Briefly, PLCL polymer (CorbionPurac, Netherlands) and galantamine were dissolved in an organic solvent and added dropwise to an aqueous phase under continuous stirring. Following solvent evaporation, the nanoparticle suspension was lyophilized to obtain a dry nanoparticle powder.

MTT Cell Viability Assay: SH-SY5Y cells were exposed to PLCL-galantamine nanoparticles (3.125-100 µg/mL)[11] or $AlCl_3$ (15.8-500 µg/mL), while untreated cells served as controls. For neuroprotection studies, cells were pretreated with PLCL-galantamine nanoparticles for 24 h before exposure to $AlCl_3$ (500 µg/mL). The cell viability was determined using the MTT test. After treatment, MTT solution (0.5 mg/mL) was added and incubated for 4 hours at 37°C. Formazan crystals were dissolved in DMSO and the absorbance was measured at 570 nm. All experiments were done in triplicate.

For gene expression, SH-SY5Y cells were cultured in six-well plates and allocated to five treatment groups: $AlCl_3$ alone, free galantamine alone, $AlCl_3$ combined with free galantamine, PLCL-galantamine nanoparticles alone, and $AlCl_3$ combined with PLCL-galantamine nanoparticles. Total RNA was extracted using the FavorPrep™ Blood/Cultured Cell Total RNA Kit (Favorgen, Korea). Complementary DNA was created using the AddScriptcDNA Synthesis Kit (Addbio, Korea). The GoTaq® qPCR System (Promega, USA) was used to run quantitative RT-PCR on an Mx3005P Stratagene Real-Time PCR System (Agilent Technologies, USA). PIK3CA expression was measured using SYBR Green chemistry, with GAPDH as the internal reference gene. The $2^{-}\Delta\Delta Ct$ technique was employed to quantify relative expression levels, with untreated cells serving as the calibration standard. All analyses were conducted in biological duplicates. The data were examined with SPSS software. One-way ANOVA was used to analyze group differences, which were then followed by Tukey's post-hoc test. Statistical significance was determined at $p < 0.05$.

RESULTS

The synthesized PLCL nanoparticles were predominantly spherical with smooth surfaces and particle sizes ranging from 69 to 108 nm, indicating suitability for drug-delivery applications (Fig. 1). The nanoparticles remained structurally stable under a 10 kV electron beam, reflecting good matrix stability. FT-IR analysis revealed the effective encapsulation of galantamine within the PLCL matrix. The absorption peaks at 3294, 1637, 1371, 1238, and 1094 cm^{-1} correspond to the O-H/N-H, C=O, and C-O functional groups.The absence of major peak shifts suggested physical entrapment of galantamine without detectable chemical degradation or interaction with the polymer (Fig. 2). PLCL-galantamine nanoparticles exhibited minimal cytotoxicity toward SH-SY5Y cells across the tested concentration range (3.125-100 µg/mL), maintaining cell viability close to control values. Statistical analysis revealed significant differences across experimental groups ($P<0.001$), with the 100 µg/mL concentration resulting in a significant decrease in viability compared to the control ($P = 0.002$) [Fig. 3]. Exposure to $AlCl_3$ markedly reduced cell viability. However, pretreatment with PLCL-galantamine nanoparticles significantly improved cell survival, with the greatest protective effect observed at 6.25 µg/mL.

Pretreatment with PLCL-galantamine nanoparticles (3.125–100 µg/mL) improved cell viability following exposure to $AlCl_3$ (500 µg/mL), significant differences among the experimental groups ($P<0.001$). Concentrations of 25, 50, and 100 µg/mL resulted in significant decreases in viability compared to the control ($P = 0.006$, 0.034, and 0.016) [Fig. Fig. 4].

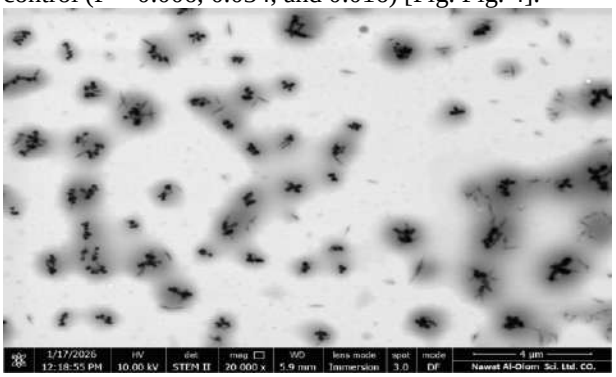


Figure No. 1: STEM micrograph of the synthesized PLCL nanoparticles demonstrating their morphology and distribution

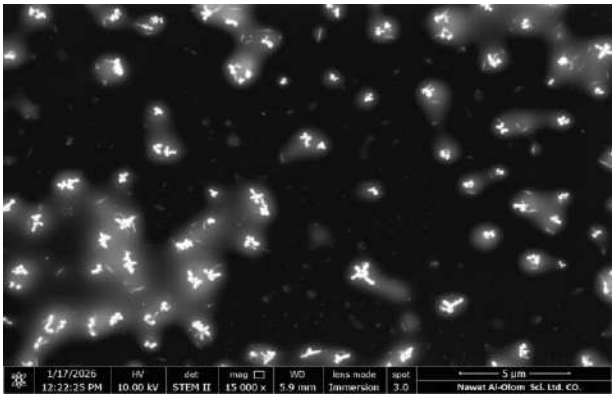


Figure No. 2: STEM image showing PLCL nanoparticles as bright, mostly spherical to near-spherical structures dispersed on a dark background

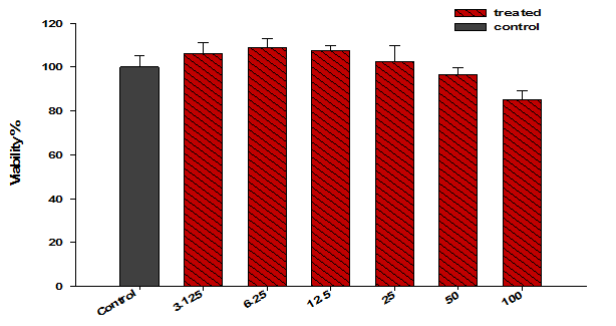


Figure No. 3: The viability of SH-SY5Y cells after treatment with PLCL-galantamine nanoparticles (3.125-100 µg/mL)

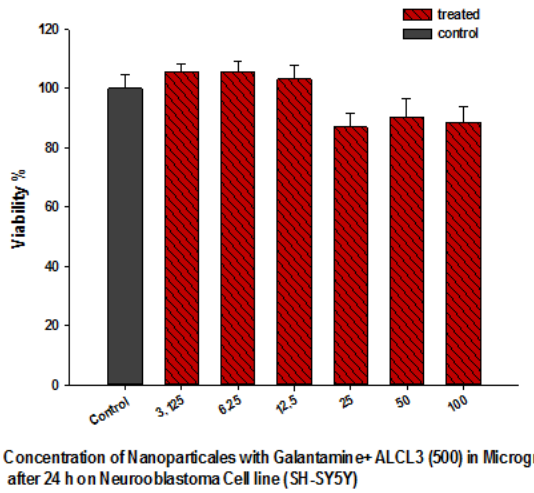


Figure No. 4: Protective effect of PLCL-galantamine nanoparticles against $AlCl_3$-induced cytotoxicity in SH-SY5Y cells

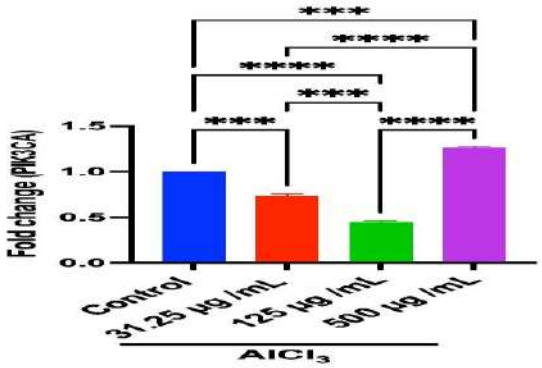


Figure No. 5: Relative expression of PIK3CA genes in SH-SY5Y cells treated with various doses of $AlCl_3$

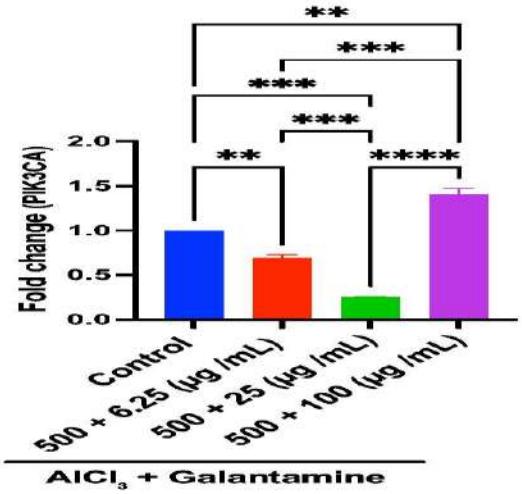


Figure No. 6: Relative expression of PIK3CA genes in SH-SY5Y cells treated with galantamine galantamine plus $AlCl_3$

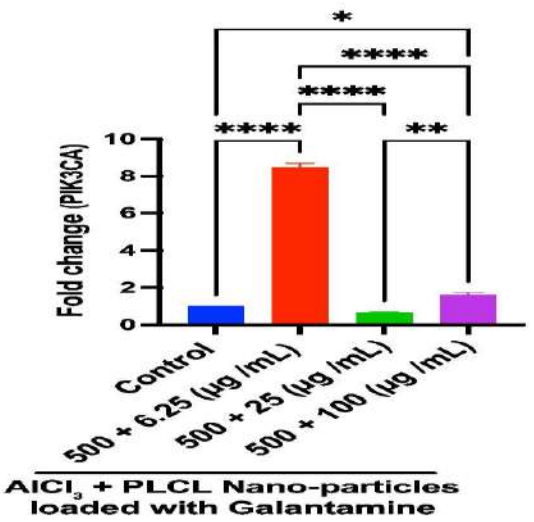


Figure No. 7: Relative PIK3CA gene expression in SH-SY5Y cells exposed to PLCL-galantamine nanoparticles combination with $AlCl_3$

$AlCl_3$ significantly altered PIK3CA expression in a concentration-dependent manner ($p < 0.0001$). Expression decreased at 31.25 and 125 µg/mL (fold changes: 0.735 and 0.449, respectively) but increased above control levels at 500 µg/mL (fold change: 1.266), resulting in a U-shaped response pattern. Gene expression is shown as a fold change compared to the untreated control group and the mean of biological duplicates [n=2] (Fig. 5).

Free galantamine significantly modulated PIK3CA expression. All tested concentrations reduced expression below control levels, with the strongest suppression observed at 25 µg/mL. Partial recovery was detected at 100 µg/mL. When combined with $AlCl_3$, galantamine produced concentration-dependent effects. The 6.25 and 25 µg/mL concentrations reduced PIK3CA expression, whereas 100 µg/mL induced significant upregulation above control levels (fold change: 1.410). Gene expression is measured as fold change relative to the untreated control. Data reflect the average of biological duplicates (n=2) [Fig. 6].

PLCL-galantamine nanoparticles significantly influenced PIK3CA expression. The nanoformulation produced marked upregulation at 100 µg/mL, whereas lower concentrations generated variable responses. Notably, nanoparticle treatment resulted in an approximately 8.6-fold increase in PIK3CA expression, representing the strongest molecular response observed in this study. In $AlCl^3$-treated cells, PLCL-galantamine nanoparticles significantly modified gene expression patterns. The 6.25 µg/mL concentration produced the highest PIK3CA expression (8.487-fold increase; $p<0.0001$), while 100 µg/mL also increased expression above control levels. In contrast, the 25 µg/mL concentration resulted in reduced expression relative to the control group. Gene expression is measured as a fold change from the untreated control. The data represents the average of biological duplicates (n=2) [Fig. 7]

DISCUSSION

Free galantamine exhibited concentration-dependent effects in SH-SY5Y cells. While lower concentrations maintained cellular viability, higher concentrations, particularly 100 µg/mL, were associated with reduced viability and suppression of PIK3CA expression, suggesting impaired activation of the PI3K/Akt survival pathway. These findings indicate that excessive galantamine exposure may shift from a protective to a potentially cytotoxic effect. In contrast, PLCL-galantamine nanoparticles markedly enhanced PIK3CA expression, producing up to an 8.6-fold increase compared with the control. This response was not observed with free galantamine, suggesting that nanoencapsulation alters the cellular activity of the drug. The marked increase in PIK3CA expression observed with PLCL-galantamine nanoparticles may be attributed to several mechanisms. First, unlike free galantamine, PLCL nanoparticles are internalized through endocytic pathways, improving intracellular drug delivery and cellular uptake.[12]

The persistent release of galantamine from the nanoparticle matrix might give extended stimulation of nicotinic acetylcholine receptors (nAChRs), leading to activation of downstream PI3K/Akt survival signaling pathways.[13,14]

In addition, degradation of PLCL may generate L-lactic acid, which has been associated with PI3K-dependent activation of HIF-1α signaling and subsequent regulation of genes involved in cell survival, including PIK3CA.[9,15]

Consistent with previous reports, $AlCl_3$ reduced SH-SY5Y cell viability and altered PIK3CA expression in a concentration-dependent manner. These effects are commonly Linked to oxidative stress, mitochondrial malfunction, and disruption of pro-survival signaling pathway.[16,17] At lower concentrations aluminum exposure affects the PI3K/Aktsignaling pathway, often causing its downregulation in conjunction with neuronal damage.[10] This impact is achieved by various processes, including oxidative stress and regulation of regulatory pathways such as PTEN-AKT signaling, rather than direct suppression of PI3K lipid kinase activity.[18] At high toxic doses, aluminumcauses reactive oxygen species (ROS) excess production or severe oxidative damage[19] which may trigger compensatory activation or dysregulation of the same pathway.[20]

The increase in PIK3CA expression (fold change = 1.41) observed in cells treated with 100 µg/mL galantamine plus $AlCl_3$, together with substantial recovery of cell viability, supports the involvement of PI3K/Akt-mediated neuroprotection. Activation of α7 nicotinic acetylcholine receptors has been linked to enhanced PI3K/Aktsignaling, increased expression of

anti-apoptotic proteins, and improved neuronal survival following toxic insults.[21] The concentration-dependent pattern observed in this study may indicate a threshold level of receptor activation required for effective engagement of this pathway.[22]

Notably, PLCL-galantamine nanoparticles provided the strongest protective effect against $AlCl_3$-induced toxicity. Pretreatment restored cell viability and markedly increased PIK3CA expression, reaching an 8.49-fold increase at 6.25 µg/mL. This response may reflect the combined effects of enhanced nanoparticle uptake and activation of intracellular survival pathways, ultimately promoting resistance to oxidative stress and apoptosis.[23]

At the intermediate nanoparticle concentration (25 µg/mL), cell viability remained stable, yet the increase in PIK3CA expression was lower than expected. This may be explained by negative feedback regulation within the PI3K/Akt pathway. When this pathway becomes activated, cells can upregulate regulatory proteins such as PTEN, which converts PIP_3 back to PIP_2 and thereby dampens further signaling. In this way, PTEN acts as a natural brake, preventing excessive or prolonged activation of pro-survival pathways. Such feedback mechanisms are well recognized as essential for maintaining cellular balance and avoiding uncontrolled growth or overstimulation of survival signals.[24]

This study demonstrating modulation of PIK3CA expression by PLCL-galantamine nanoparticles in an $AlCl_3$-induced neurotoxicity model and nevertheless, the study is limited to an in vitro system. Future investigations should validate these findings in vivo and assess PI3K/Akt pathway activation at the protein level. Overall, the findings suggest that PLCL-based nanoformulation not only improves galantamine delivery but also enhances signaling pathways associated with neuronal survival.

CONCLUSION

The nanoencapsulation of galantamine within PLCL nanoparticles significantly changes its molecular and cellular effects. Unlike free galantamine, which suppresses PIK3CA expression, the PLCL-based nanoformulation strongly enhances its expression and restores cell viability under $AlCl_3$-induced stress, suggesting a potential role in supporting cell survival pathways.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Luma Ali Mahmoud, Rana Ayad Ghaleb
Drafting or Revising Critically:	Luma Ali Mahmoud, Aymen A. Bash
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

Conflict of Interest: The study has no conflict of interest to declare by any author.

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Original Article

The Real-World Spectrum of Coronary CT Angiography Findings: Patterns and Vessel Distribution

Emad Ali Al Khoufi

ABSTRACT

Objective: To describe the spectrum of documented CCTA findings, the extent of coronary involvement, and the distribution of involved coronary territories in a tertiary-care clinical dataset.
Study Design: Retrospective observational cross-sectional study.
Place and Duration of Study: This study was conducted at the Tertiary Cardiac Center, Saudi Arabia, from 6th May 2026 to 30th July 2026.
Methodology: This retrospective cross-sectional study was conducted in 2026 using historical clinical/procedural records from patients attending the cardiac clinic or catheterization service between 1 September and 31 December 2025. The study was approved by the Research Ethics Committee of King Faisal University in May 2026. After excluding records without a usable coronary CCTA entry and four non-coronary vascular CT entries, 172 eligible CCTA-related records remained. To avoid repeated counting, one index record per patient was used, yielding 153 patients for analysis.
Results: Among 153 index CCTA records, 113 (73.9%) documented severe stenosis, total occlusion, or explicit three-vessel disease; 29 (19.0%) documented moderate disease, 3 (2.0%) mild disease, and 3 (2.0%) normal coronary arteries. Five records (3.3%) contained other coronary findings that could not be placed in these stenosis categories. A single or isolated named coronary territory was documented in 104 patients (68.0%), while 40 (26.1%) had multi-vessel involvement. LAD territory involvement was most frequent (102, 66.7%), followed by RCA (52, 34.0%) and LCX (35, 22.9%); multiple territories could be present in one patient.
Conclusion: The analyzed tertiary-care records showed a predominance of advanced coronary findings and frequent LAD involvement. These results describe a selected clinical population and should not be interpreted as population prevalence. Standardized prospective CCTA reporting would improve future analyses of disease pattern and distribution.

Key Words: coronary computed tomography angiography; coronary artery disease; vessel distribution; multivessel disease; tertiary care; retrospective study

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INTRODUCTION

Coronary artery disease (CAD) remains a major cause of cardiovascular morbidity and mortality. CCTA has become an established non-invasive anatomical test for patients with suspected coronary disease and is incorporated into contemporary chest-pain pathways[1].

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The 2024 European Society of Cardiology guideline also places CCTA among the principal first-line anatomical tests for chronic coronary syndromes[2].

CCTA describes more than the presence or absence of an obstructive lesion. Standardized systems such as CAD-RADS 2.0 emphasize stenosis severity, plaque burden, and modifiers that can affect interpretation and management[3]. Randomized evidence from SCOT-HEART showed that adding CCTA to standard assessment can alter diagnosis and management and was associated with improved long-term coronary outcomes[4]. PROMISE demonstrated the practical role of anatomical testing in a large population with stable chest pain[5], while the DISCHARGE trial further established CT as a clinically useful anatomical strategy in selected patients referred for evaluation of stable chest pain[6].

The clinical value of CCTA also depends on the pattern of disease that is identified. Plaque characteristics on

CCTA have been associated with subsequent cardiovascular events[7], and contemporary reviews emphasize the contribution of CCTA to anatomical risk stratification[8]. Meta-analytic data support the prognostic value of CCTA findings across clinical populations[9]. Even non-obstructive CAD detected on CCTA may carry prognostic information and may influence preventive treatment[10].

The distribution of findings seen in practice is strongly influenced by referral setting. Patterns reported by a tertiary cardiac service may differ from those in lower-risk outpatient or screening populations because patients with established CAD, previous revascularization, recurrent symptoms, or complex anatomy are more likely to be represented. Geographic variation in CCTA use and referral has also been documented[11]. Changes in medical management after CCTA further illustrate why local case mix and the spectrum of recorded findings are clinically relevant[12].

For this reason, a clear description of the CCTA findings encountered in routine tertiary practice can provide useful information about local disease patterns without implying population prevalence. The present study therefore aimed to describe the spectrum of documented CCTA findings, the extent of coronary involvement, and the distribution of involved coronary territories in a tertiary-care clinical dataset.

METHODOLOGY

Study design, setting, and chronology: This retrospective cross-sectional study was conducted in 2026 at a tertiary cardiac center using historical clinical/procedural records. The study population was drawn from patients attending the cardiac clinic or catheterization service between 1 September and 31 December 2025. The study was approved by the Research Ethics Committee of King Faisal University on 5 May 2026 (KFU-REC-2026-MAY-ETHICS4265).

Study population and eligibility: The source dataset contained 471 clinical/procedural records during the study period. Records were eligible when a coronary CCTA finding was documented in the designated CCTA field. Records with a blank entry or an entry documented as "No CT" were not included. Four entries represented non-coronary vascular CT findings (aortic/abdominal aortic aneurysm or peripheral arterial findings) and were excluded. This left 172 eligible coronary CCTA-related records from 153 unique patients. Because some patients appeared more than once, the first eligible record during the study period was defined as the index record; 19 additional records from repeated patients were not counted again in the patient-level analysis.

CCTA data and classification: The analysis used the documented CCTA interpretation available in the source records. Original scanner acquisition parameters, image-quality scores, and complete CAD-RADS variables were not consistently available, and the CT images were not re-read for this study. The recorded text was therefore classified conservatively according to the information explicitly documented.

For the spectrum analysis, index records were grouped as: normal coronary arteries; mild CAD; moderate CAD/stenosis; severe stenosis, total occlusion, or explicitly documented three-vessel disease; and other coronary findings. Entries describing severe calcification without an accompanying stenosis grade, a patent stent, or a jailed branch were retained as "other coronary findings" rather than being assigned a stenosis category. No severity was inferred when it was not stated.

For anatomical distribution, LAD territory included LAD and diagonal-branch descriptions; LCX territory included LCX and obtuse-marginal descriptions; and RCA territory included RCA and posterior descending artery descriptions. Left-main, ramus intermedius, and graft findings were recorded separately. Explicit "3VD" entries were counted as involving LAD, LCX, and RCA territories. Because more than one territory could be involved in a patient, vessel-specific percentages are not mutually exclusive. Disease extent was classified as normal, single/isolated named territory, multivessel involvement, or no specific vessel named.

Statistical analysis: The analysis was descriptive and patient based. Categorical variables are reported as counts and percentages using 153 index patients as the denominator. No CCTA-versus-invasive-coronary-angiography comparison, diagnostic-accuracy calculation, or inferential model was included in the present analysis because these were outside the descriptive study objective.

RESULTS

From 471 source records, 176 contained a CT finding in the CCTA field. Four non-coronary vascular CT entries were excluded, leaving 172 eligible coronary CCTA-related records. These represented 153 unique patients; after selecting one index record per patient, the final patient-level analysis included 153 CCTA records (Figure 1).

Table No.1: Spectrum of documented CCTA findings (n = 153 patients)

Documented CCTA category	n	%
Severe stenosis, total occlusion, or explicit 3VD	113	73.9
Moderate CAD/stenosis	29	19.0
Mild CAD	3	2.0
Normal coronary arteries	3	2.0
Other coronary finding	5	3.3
Total	153	100.0

Categories were assigned from the documented CCTA text. "Other" included findings such as severe calcification without a stated stenosis grade, patent stent, or jailed branch.

Demographic and cardiovascular risk-factor fields were available for only a small minority of the index records and were therefore not summarized as cohort characteristics.

Advanced findings predominated. Severe stenosis, total occlusion, or explicitly documented three-vessel disease was present in 113 patients (73.9%). Moderate disease was documented in 29 (19.0%), while mild disease and normal coronary arteries were each documented in 3 patients (2.0%). Five patients (3.3%) had other coronary findings that could not be assigned reliably to the stenosis categories (Table 1).

Table No. 2: Extent of documented coronary involvement (n = 153 patients)

Extent category	n	%
Single/isolated named coronary territory	104	68.0
Multivessel involvement	40	26.1
No specific vessel named	6	3.9
Normal coronary arteries	3	2.0
Total	153	100.0

Multivessel involvement was based on two or more named major epicardial territories or an explicit 3VD entry.

A single or isolated named coronary territory was recorded in 104 patients (68.0%), whereas 40 (26.1%) had multivessel involvement. Six records (3.9%) described coronary disease without naming a specific vessel, and 3 (2.0%) were normal (Table 2).

Table No.3: Distribution of documented coronary territories (n = 153 patients)

Coronary territory	n	% of patients
LAD territory	102	66.7
RCA territory	52	34.0
LCX territory	35	22.9
Ramus intermedius	5	3.3
Left main	3	2.0
Coronary graft	3	2.0

Multiple territories could be documented in the same patient; therefore, percentages do not sum to 100%. LAD includes diagonal branches, LCX includes obtuse-marginal branches, and RCA includes PDA descriptions.

LAD territory was the most frequently documented location, occurring in 102 patients (66.7%). RCA and LCX territories were documented in 52 (34.0%) and 35 (22.9%), respectively. Left-main involvement was recorded in 3 patients (2.0%). Because multivessel disease was common, these vessel-specific categories overlap (Table 3).

DISCUSSION

This revised analysis addresses a single question: what spectrum and anatomical distribution of CCTA findings was documented in the selected tertiary-care population? The main observation was the predominance of advanced coronary findings. Nearly three quarters of index records described severe stenosis, total occlusion, or explicit three-vessel disease. This should be interpreted as a feature of the source population rather than as an estimate of CAD prevalence in the community.

The selected nature of the cohort is clinically plausible. CCTA is now an important non-invasive anatomical test in the assessment of suspected CAD and can influence subsequent diagnostic and therapeutic decisions[13]. Its value extends beyond identifying a single stenosis: it can define the location and extent of coronary disease, demonstrate non-obstructive atherosclerosis, and identify patterns that may guide preventive treatment or the need for further evaluation[10,14]. The clinical meaning of these findings nevertheless depends on the referral population and pre-test context, which is particularly relevant in a tertiary cardiac service[15].

LAD territory was the most frequently documented coronary location in the present dataset. A regional CCTA study has also reported substantial variation in coronary anatomical patterns and disease distribution[16]. Direct numerical comparison is difficult because populations, definitions, and reporting methods differ. In our analysis, vessel percentages were intentionally allowed to overlap so that multivessel records could contribute to each documented coronary territory rather than being forced into a single mutually exclusive vessel category.

The high proportion of advanced findings also reflects the referral profile of a tertiary clinical/procedural population. CCTA has high sensitivity for coronary disease in appropriately selected patients[17], but an anatomical estimate of stenosis on CT does not by itself establish the physiological significance of a lesion. Heavy coronary calcification and related technical limitations can impair lumen assessment and may lead to overestimation of stenosis severity[18,19]. In clinical practice, an apparently severe or equivocal lesion on CCTA may therefore require further assessment when the result will determine revascularization, including invasive angiography and, for selected intermediate lesions, physiological assessment. This distinction is relevant to the present cohort, although the current study was not designed to measure CCTA-ICA agreement or functional significance.

The present findings should therefore be interpreted as a description of what CCTA contributed anatomically in routine tertiary practice rather than as a diagnostic-accuracy analysis. The study shows that CCTA records in this setting contained information ranging from normal or mild disease to severe stenosis, occlusion, and multivessel involvement, with LAD involvement particularly common. This breadth is clinically useful because both non-obstructive and obstructive CCTA findings carry prognostic information and may influence preventive treatment and downstream

investigation[10,21]. At the same time, CCTA should be viewed as one component of clinical decision-making rather than a substitute for physiological assessment when the functional significance of a particular stenosis remains uncertain. Current international guidance continues to support CCTA as an important anatomical test in chronic coronary syndromes[2,22].

CONCLUSION

In this tertiary-care patient-level analysis, advanced coronary findings were common and LAD was the most frequently documented coronary territory. Multivessel involvement was present in approximately one quarter of patients. These findings characterize the selected clinical dataset and should not be interpreted as population prevalence. Prospective collection using standardized CCTA reporting and complete clinical variables would allow more detailed assessment of disease patterns and their clinical significance.

Limitations: This study has several limitations. It was retrospective, single-center, and based on a selected tertiary-care clinical/procedural dataset rather than a population-based CCTA registry. The source dataset did not contain complete demographic, risk-factor, indication, scanner, image-quality, or standardized CAD-RADS information for the full cohort. Consequently, these variables could not be analyzed reliably. CCTA findings were classified from documented text and the original images were not re-read. Some source descriptions were non-standardized, requiring conservative grouping; no unstated severity or vessel involvement was inferred. Although 172 eligible CCTA-related records were identified, repeated appearances of the same patient were present, so one index record per patient was used to avoid repeated counting. This choice may omit later findings recorded during the study period. The high proportion of severe disease likely reflects referral and selection patterns and should not be generalized to the wider community. Clinical outcomes were not assessed.

Author's Contribution:

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Drafting or Revising Critically:	Emad Ali Al Khoufi
Final Approval of version:	The above author
Agreement to accountable for all aspects of work:	The above author

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Original Article

First Aid Knowledge Among Physical Education Students Toward Sport Injuries: A National Cross-Sectional Study

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ABSTRACT

Objective: This study aims to assess the level knowledge of first aid among physical education students toward sport injuries.

Study Design: A cross sectional study

Place and Duration of Study: This study was conducted at the University of Mosul / College of Physical Education and Sports Sciences from 4th November, 2025 until 1st April, 2026.

Methodology: The study was carried out at the university of Mosul / College of physical education and sports sciences to determine the level of the students' knowledge of first aid for sports injuries. The researchers employed non-probability sampling method (purposive sampling). There were 100 male and female students in the sample. The researchers using SPPS. Version 28 to analysis the data.

Results: The highest age group were 21-23 years (67 respondents, 67.7%) as shown in the table. The number of male students in the sample was 55.6%. Signs of a sprain (74.7%), definition of first aid (73.7%), importance of having a first aid kit in sports venues (73.7%) and prevention of sports injuries through warm-up and stretching (69.7%) had the highest proportions of correct responses.

Conclusion: The overall pattern of the knowledge was very slightly towards the low score category, but not too big a difference between the two.

Key Words: First Aid, Knowledge, Physical Education, Sport injuries.

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INTRODUCTION

First aid according to the World Health Organization (WHO) Community First Aid Response is the initial assessment and immediate intervention performed during a health emergency or injury before professional medical care arrives[1]. Injury is a part of playing sport, especially as it pertains to students who play actively. Participated in physical education activities. With increasing physical demands and competitive sports injuries have become a concern among youth athletes and students in environments[2].

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A knowledge and understanding of mechanisms of injury and injury prevention, and first aid responses are crucial to building a safe sporting culture[3]. Many students in physical education will become coaches, trainers and physical educators. Hence it's essential to provide them with injury awareness and injury prevention knowledge, both of which are essential to them. The safety of people and the well-being of the people they will be training in the future[4]. Injury education is a critically important topic, but many curricula have more of an emphasis on. Despite the need for high technical skills and physical fitness, injury prevention training is not often a priority [5]. According to the National First Aid Science Advisory Board, First Aid involves an assessment and the implementation of interventions that the victim or bystander can perform with little or no medical supplies. But there are some requirements of knowledge and practice to this implementation. Over the years there has been a number of studies which have assessed the level of first aid knowledge amongst various populations including University students conducted worldwide[6]. Some studies have found that large proportions of students in various countries are unable

to perform basic first aid. Similarly, many studies found that most people don't have any first aid training or very little. Possession of a driver's license, completion of a first-aid course at school and higher level of education were all known to be associated with good knowledge[7]. Research shows that more than 50 percent of all post-accident fatalities take place in the first 30 minutes, and 10-35 percent in the first five minutes. However, 38% of all deaths are preventable if the first aid used at the scene is appropriate and informed and it has been proved that first aid given in the first 5 minutes is most effective. 80% of patients in urban areas receive an ambulance in 10 minutes or less and 80% of patients in rural areas receive an ambulance in 16 minutes or less[8]. This study aims to assess the level knowledge of first aid among physical education students toward sport injuries.

METHODOLOGY

A descriptive cross-sectional study was used for this study. The present study was conducted in university of Mosul /College of physical education. A study initiated on January 16th, 2026, and extended through June 2026.The researchers used non-probability (purposive) sampling technique. The sample included (100) males and females students from second, third and fourth academic stages belonging to the college of physical education and sports sciences at university of Mosul. Information was gathered from previous literature related to the same research topic to design a questionnaire. The resulting questionnaire consisted of two parts: the first part included demographic information (Age, gender, study stage, previous study of first aid, participation in training course, regular sports practice and experienced or witnessed a sports injury) of the participant sample. The second part tested students' knowledge of first aid for sports injuries, consisting of 20 multiple-choice questions. This questionnaire was presented to 11 experts of different medical, nursing and statistical fields to test the content of the questionnaire and the research title. Impartiality was assured by excluding the same number of 20 students from the same college from the study, and running a pilot study with them. Lastly, the reliability of the instrument was tested with Cronbach's alpha coefficient with the results that the instrument's internal consistency was obtained at 0.77 which was deemed acceptable. Researchers used the statistical analysis program (SPSS, Version 31) to assess students' knowledge regarding first aid for sports injuries, the researcher using the descriptive analysis included t-test, chi-square, mean, stander deviation, frequency and percentage.

RESULTS

Table (1) reveals that the highest number of participant belonged to age group 21-23 years (67.7%). The male students constituted 55.6% of the sample, whereas, the female students constituted 44.4% of the sample. The study stage of the respondents was dominated by the Second stage students (61 respondents, 61.6%). Almost half (48.5%) said that they had learned a subject or course on first aid before, while 51.5% had not. Table 2: Inferentially, 13 out of 20 items were found at 0.05 significance level, of which 12 were highly significant. This means the students' knowledge was not evenly distributed in the questionnaire. Academically there seems to have been an increased awareness of some common sports injury situations and a lack of awareness of more specific first-aid skills and emergency priorities. None of the socio-demographic variables were significant at the .05 level for the dichotomization of low/high score levels as shown in Table 3.

Table No.1: The Demographic Characteristics of the Sample in the Study

Demographic variable	Category	Freq.	%	C.S.	P-value	Sig.
Age	Less than 20 years	15	15.2%	52.606	<.001	H.S
	21–23 years	67	67.7%			
	More than 23 years	17	17.2%			
Gender	Male	55	55.6%	1.222	0.269	N.S
	Female	44	44.4%			
Study Stage	Second stage	61	61.6%	49.273	<.001	H.S
	Third stage	34	34.3%			
	Fourth stage	4	4.0%			
Previous study of first aid	Yes	48	48.5%	0.091	0.763	N.S
	No	51	51.5%			
Participation in training course	Yes	33	33.3%	11.000	<.001	H.S
	No	66	66.7%			
Regular sports practice	Yes	65	65.7%	9.707	0.002	H.S
	No	34	34.3%			
Experienced or witnessed a sports injury	Yes	76	76.8%	28.374	<.001	H.S
	No	23	23.2%			

Table No.2: Descriptive association between questions related to students' knowledge regarding first aid for sports injuries

Questions	Correct	%	Incorrect	%	Cum.%	C.S.	P-value
Definition of first aid	73	73.7	26	26.3	100%	H.S	<.001
Main goal of first aid	23	23.2	76	76.8	100%	H.S	<.001
First step when dealing with an injured player on the field	31	31.3	68	68.7	100%	H.S	<.001
Correct positioning during a nosebleed	34	34.3	65	65.7	100%	H.S	0.002
Proper action in case of fracture	56	56.6	43	43.4	100%	N.S	0.191
Meaning of the R.I.C.E. method	28	28.3	71	71.7	100%	H.S	<.001
Signs of sprain	74	74.7	25	25.3	100%	H.S	<.001
First step for external bleeding	63	63.6	36	36.4	100%	H.S	0.007
Priority action in case of loss of consciousness	41	41.4	58	58.6	100%	N.S	0.088
Correct action when neck or spinal injury is suspected	52	52.5	47	47.5	100%	N.S	0.615
Proper first aid for muscle cramp	46	46.5	53	53.5	100%	N.S	0.482
Recommended duration of ice application	42	42.4	57	57.6	100%	N.S	0.132
Appropriate action in head injury	65	65.7	34	34.3	100%	H.S	0.002
First aid for elevated body temperature during exercise	47	47.5	52	52.5	100%	N.S	0.615
Importance of having a first aid kit in sports venues	73	73.7	26	26.3	100%	H.S	<.001
Proper response to a seizure in an athlete	15	15.2	84	84.8	100%	H.S	<.001
Best way to prevent sports injuries	69	69.7	30	30.3	100%	H.S	<.001
Recommended action in exercise-related dehydration	60	60.6	39	39.4	100%	S	0.035
Symptoms of shock	40	40.4	59	59.6	100%	N.S	0.056
Characteristics of a good first aider	66	66.7	33	33.3	100%	H.S	<.001

Table No.3: Association between Score Level and Socio-demographic Variables

Variable	Category	Low score n	Low score %	High score n	High score %
Age	Less than 20 years	6	40.0	9	60.0
	21–23 years	39	58.2	28	41.8
	More than 23 years	7	41.2	10	58.8
Gender	Male	29	52.7	26	47.3
	Female	23	52.3	21	47.7
Study Stage	Second stage	31	50.8	30	49.2
	Third stage	21	61.8	13	38.2
	Fourth stage	0	0.0	4	100.0
Previous study of first aid	Yes	23	47.9	25	52.1
	No	29	56.9	22	43.1
Participation in training course	Yes	19	57.6	14	42.4
	No	33	50.0	33	50.0
Regular sports practice	Yes	33	50.8	32	49.2
	No	19	55.9	15	44.1
Experienced or witnessed a sports injury	Yes	36	47.4	40	52.6
	No	16	69.6	7	30.4

Table No.4: Comparison of mean total knowledge score according to socio-demographic variables

Variable	Category	n	Mean ± SD	Test	Statistic	P-value	Sig.
Age	Less than 20 years	15	10.40 ± 4.37	ANOVA	0.644	0.528	N.S
	21–23 years	67	9.81 ± 3.60				
	More than 23 years	17	10.88 ± 3.39				
Gender	Male	55	9.84 ± 3.69	t-test	0.738	0.462	N.S
	Female	44	10.39 ± 3.68				
Study Stage	Second stage	61	10.38 ± 3.31	ANOVA	4.369	0.015	S
	Third stage	34	9.06 ± 4.07				
	Fourth stage	4	14.25 ± 1.71				
Previous study of first aid	Yes	48	10.23 ± 3.57	t-test	0.389	0.698	N.S
	No	51	9.94 ± 3.80				
Participation in training course	Yes	33	9.21 ± 3.30	t-test	-1.760	0.083	N.S
	No	66	10.52 ± 3.80				
Regular sports practice	Yes	65	10.57 ± 3.23	t-test	1.694	0.096	N.S
	No	34	9.15 ± 4.30				
Experienced or witnessed a sports injury	Yes	76	10.82 ± 3.17	t-test	3.318	0.002	H.S
	No	23	7.65 ± 4.23				

However, a few descriptive differences should be noted. The percentages of students with high scores were relatively higher in the 4th stage (100.0%, but represented a small group), students with prior experience of or witness to a sports injury (52.6% high score), and students younger than 20 years or older than 23 years compared to those aged 21–23 years. Table 4: Descriptively, highest mean total score was obtained by fourth stage students (14.25 ± 1.71), students who have experienced or witnessed sports injuries (10.82 ± 3.17), students more than 23 years old (10.88 ± 3.39) and students who were involved in sports regularly (10.57 ± 3.23). The mean score of the students without any exposure to injury were definitely lower (7.65 ± 4.23). Academically significant, as the result suggests that background variables alone might not be as effective as direct exposure to sports injury situations in learning to recognize and be aware of first-aid.

DISCUSSION

The results indicate that the level of knowledge about first aid for sports injuries among the Physical Education College students is moderate and is somewhat scattered. Nearly half of the students earned a high score, but the group as a whole was skewed slightly toward the low score. This means that pupils have a good general understanding of first aid but many lack a good awareness in every set of questions on the questionnaire. There was a positive correlation between prior first aid experience and the first aid knowledge among students. The findings are similar to those obtained in a study that was done in Turkey. This research is similar to that of [9,10]. The student's average knowledge of handling sports injuries is 61.8. The mean of internal and external handling sports injuries knowledge are 56.14 and 64.91 respectively. It is bad because students' knowledge has not been optimized so that it will have an impact on their ability to deal with sports injuries as they play or practice sports. Statistically significant relationships were not found with the 7 demographic variables: score-level association analysis. The mean-score comparison was more sensitive, however. Specifically, study stage and previous experience and observation of sports injuries were significantly correlated with mean knowledge scores, while a similar relationship was observed among the university students [11,12]. Also, a study revealed that the vast majority of people lacked any first aid training and that there was a direct correlation between first aid training and type of first aid measures taken by general population who witnessed accidents[13].This study challenges the findings of [14,15] that females were knowledgeable more than males regarding first aid procedure. The results of a survey carried out in India, which showed that 11.5% of boys and 15.4% of girls had strong understanding about first aid procedures. The study coincides with [17,18], where the students in the study year showed low knowledge, which may be due to the low study year of the students of health sciences college.[19,20] The overall response confirms the necessity for improving the knowledge of first-aid in college related to sports injuries. Repeated field-based refresher sessions, simulation sessions, demonstration-based teaching and practical workshops may be useful when consolidating knowledge in high-risk areas, including: seizures, loss of consciousness, external bleeding, and initial assessment on the field. Students in a PE setting are likely to be one of the first people on the scene when sports injuries occur, thus it is academically and practically significant to improve these competencies.

CONCLUSION

According to the statistics, there were highly significant or significant distributional differences in age, training

course participation, regular sports practice, previous experience/witnessing of sports injury, but not in gender or previous study of first aid. The overall pattern of the knowledge was very slightly towards the low score category, but not too big a difference between the two.

Author's Contribution:

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Review Article

The Interleukin-12 (IL-12) Family: Pivotal Immunoregulatory Cytokines in Malarial Infection

Khalid Abosalif

ABSTRACT

Objective: To review the Interleukin-12 (IL-12) cytokine family in malaria, focusing on its immunoregulatory roles, contribution to disease severity, and potential clinical relevance.

Place and Duration of Study: The review was conducted at the Department of Clinical Laboratory Sciences, College of Applied Medical Sciences, Jouf University, Sakaka, Saudi Arabia from 1st Nov. 2025 to 30th June 2026.

Methodology: Relevant literature was reviewed using PubMed, Scopus, Web of Science, and Google Scholar, with emphasis on malaria-specific evidence and key studies describing IL-12 family biology.

Results: Malaria induces a tightly regulated inflammatory response in which IL-12 family cytokines help determine parasite control and immunopathology. IL-12 promotes Th1 differentiation and IFN-γ production and is particularly important in early protection. IL-23 supports Th17-associated inflammation, whereas IL-27 has stage-dependent pro- and anti-inflammatory effects. IL-35 is predominantly immunosuppressive and may limit tissue injury while also permitting parasite persistence. The magnitude and timing of these responses vary with parasite burden, host factors, and disease stage.

Conclusion: An extensive, evidence-based synthesis of the structure, immune role, and importance of the IL-12 family in malaria and considers new research on both humans and animals. The understanding of these cytokines may lead to the development of novel immunotherapeutic strategies and improved malaria control.

Key Words: Plasmodium infection, Immunopathology, Immunoregulation, Cytokines

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INTRODUCTION

Malaria remains a major infectious disease caused principally by Plasmodium falciparum and Plasmodium vivax.[1] Protective immunity requires coordinated innate and adaptive responses, yet excessive inflammation contributes to severe manifestations.[2] Cytokines are central to this balance, and the Interleukin-12 (IL-12) family, IL-12, IL-23, IL-27 and IL-35 has emerged as an important regulatory network.4 IL-12 promotes Th1 differentiation and IFN-γ production, whereas IL-23 supports Th17 responses. IL-27 can enhance early Th1 immunity but later restrain inflammation, while IL-35 is largely suppressive.[3]

Malaria therefore provides a setting in which the protective and pathological effects of these cytokines are closely intertwined. Recent studies also emphasize host genetics, parasite-driven immunoregulation, and the need to distinguish findings from experimental models from those in human disease.[4]

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METHODOLOGY

IL-12, IL-23, IL-27, and IL-35 are heterodimeric cytokines that share subunits and signaling components but have distinct functions. IL-12 is composed of p35 and p40 and signals through IL-12Rβ1/IL-12Rβ2, activating STAT4 and promoting Th1 differentiation and IFN-γ production.[5] IL-23 shares p40 with IL-12 but combines it with p19 and signals through IL-12Rβ1/IL-23R, mainly activating STAT3 and supporting Th17 responses.[6] IL-27 contains p28 and EBI3 and signals through IL-27Rα/gp130, with STAT1/STAT3 activation underlying both stimulatory and regulatory effects.[7] IL-35 consists of p35 and EBI3 and is produced mainly by regulatory lymphocytes, where it suppresses effector T-cell activity.[8] These shared

structural elements help explain why IL-12 family members can produce overlapping yet context-dependent effects during infection. Their relevance to malaria depends on the stage of infection, cellular source, local inflammatory environment, and balance between parasite elimination and host tissue injury. A further feature of this family is subunit sharing, which creates biological cross-talk between pathways. The shared p40 chain links IL-12 and IL-23 biology, whereas EBI3 contributes to both IL-27 and IL-35.[9] Receptor expression also varies between immune-cell subsets, so the same circulating cytokine concentration may produce different effects depending on which cells are present and activated. This structural organization is important when considering therapeutic blockade because targeting a shared subunit may alter more than one pathway (Fig. 1).

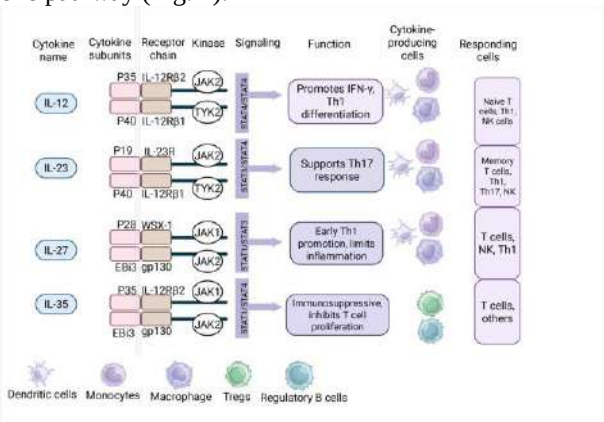


Figure No. 1: Overview of the IL-12 cytokine family, including major subunits, receptors, signaling pathways, cellular sources, and principal immunoregulatory effects

Expression of IL-12 family cytokines is strongly influenced by innate sensing of Plasmodium. Dendritic cells and macrophages respond to parasite-derived signals through pattern-recognition pathways and become important sources of IL-12 and IL-27 during early infection.[10] Plasmodium DNA and other parasite products can activate Toll-like receptor pathways, including TLR9, promoting dendritic-cell activation, NF-κB signaling, and downstream IFN-γ responses.[11] IL-23 is generally linked to maintenance of IL-17-associated inflammation, whereas IL-27 may shift from early immune activation toward later regulation.[12] IL-35 is associated mainly with regulatory T- and B-cell responses and becomes more relevant when immune suppression is established.[8] Parasite-driven IL-10 and other inhibitory mechanisms may reduce effective antigen-presenting-cell function and blunt protective cytokine responses.[5] Thus, the timing and magnitude of cytokine production are as important as absolute concentrations: insufficient early activation may permit parasite expansion, while prolonged inflammatory signaling can amplify tissue damage. Regulation also occurs beyond transcription. Cellular activation state, receptor availability, and negative-feedback pathways can modify the strength and duration of signaling. In malaria, repeated parasite exposure may therefore reshape cytokine responsiveness rather than simply increasing or decreasing cytokine production. This provides a plausible explanation for differences between primary infection, repeated exposure in endemic regions, and severe disease, and highlights why single time-point measurements can be difficult to interpret (Fig. 2).

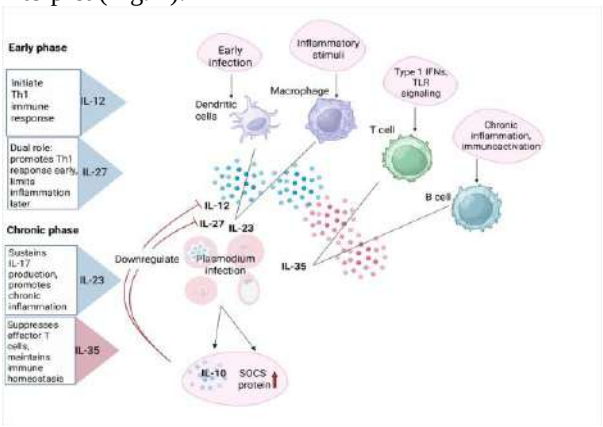


Figure No. 2: Stage-dependent roles of IL-12 family cytokines in malaria: IL-12 and IL-27 support early Th1 responses, IL-23 promotes IL-17-associated inflammation, and IL-35 contributes to immune regulation

During the early liver and blood stages, dendritic cells, macrophages, natural killer cells, and other innate populations rapidly respond to Plasmodium.[13] IL-12 is a key bridge between parasite recognition and cellular immunity because it activates natural killer cells and promotes IFN-γ production, which enhances macrophage function and supports parasite control.[14] Experimental and human studies consistently place the IL-12/IFN-γ axis among the major determinants of an effective early response.[15] IL-23 contributes indirectly by supporting IL-17-producing cells and neutrophil recruitment, although malaria-specific evidence is less extensive and excessive activation may worsen inflammation.[16] IL-27 also has a dual role, it can support early Th1 activity yet induce regulatory pathways that limit damaging inflammation.[10] These opposing effects illustrate a central feature of malaria immunity - strong early activation is desirable only if it is subsequently controlled. Failure to establish this balance may lead either to high parasitemia or to immune-mediated pathology. Innate responses also influence the quality of subsequent T-cell priming.[16]Activated dendritic cells provide cytokine and co-stimulatory signals that determine whether developing responses are predominantly inflammatory, regulatory, or functionally exhausted. In endemic settings, repeated stimulation may alter this balance and

contribute to partial clinical immunity without sterile parasite elimination. Understanding these early events is therefore relevant not only to acute disease but also to the development of naturally acquired immunity (Fig. 3).

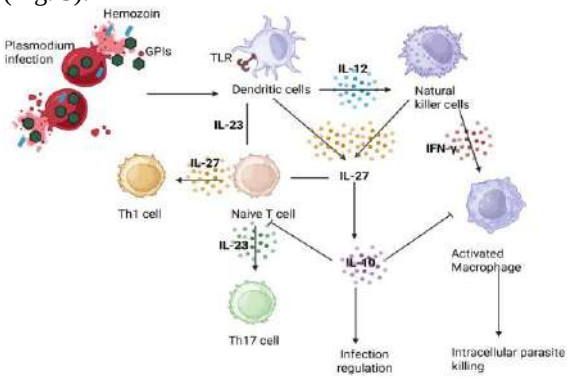


Figure No. 3: Innate sensing of Plasmodium activates dendritic-cell cytokine production. IL-12 promotes NK-cell IFN-γ responses, while IL-23 and IL-27 modulate inflammatory and regulatory pathways

Adaptive immunity is required for parasite clearance, clinical protection, and the development of immunological memory.[17] IL-12 promotes STAT4/T-bet-driven Th1 differentiation and stimulates IFN-γ production by CD4+ and CD8+ T cells, supporting control of liver-stage and blood-stage infection.[18] IL-23 maintains Th17 responses and can influence neutrophil recruitment; however, its contribution appears to vary with the inflammatory environment, and elevated IL-17-related activity has been associated with malaria in human cohorts.[16] IL-27 is again context-dependent, enhancing early Th1 responses but subsequently promoting IL-10-producing regulatory T-cell activity that limits tissue injury.[19]

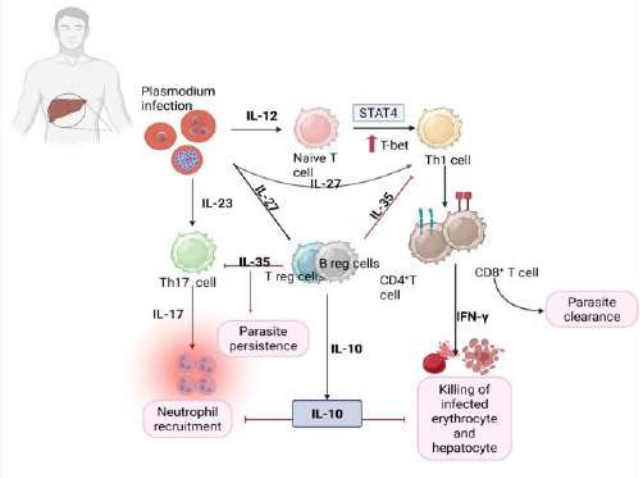


Figure No. 4: IL-12 family cytokines shape adaptive immunity in malaria by regulating Th1, Th17, CD8+ T-cell, and regulatory responses that influence parasite clearance and inflammation

IL-35, produced by regulatory lymphocytes, can suppress Th1 and Th17 responses and may therefore protect against immunopathology at the cost of weaker parasite elimination.[10] The IL-12 family consequently shapes both the strength and durability of adaptive immunity. This balance is also relevant to vaccination, because effective malaria vaccines must generate robust cellular and antibody responses without provoking persistent inflammatory or suppressive pathways.[13] CD8+ T cells are particularly relevant to the liver stage, where recognition of infected hepatocytes can limit establishment of blood-stage infection. At the blood stage, CD4+ T cells provide both inflammatory effector functions and help for B-cell responses. Regulatory pathways become increasingly important as parasite exposure continues, preventing uncontrolled inflammation but potentially reducing the efficiency of clearance. These interacting effects explain why acquired immunity to malaria develops gradually and is often incomplete (Fig. 4).

Clinical malaria ranges from asymptomatic or uncomplicated infection to severe anemia, cerebral malaria, multiorgan dysfunction, and death.[20] Disease outcome reflects both parasite burden and the host inflammatory response. IL-12 is generally associated with protective Th1 immunity and IFN-γ-mediated parasite control, although excessive or prolonged IFN-γ can contribute to pathology.[21] In contrast, heightened IL-23/IL-17 activity may amplify inflammatory injury, and increased IL-17A has been reported in malaria cohorts.[12] IL-27 can be protective when it limits excessive inflammation but may also suppress antiparasitic responses if regulatory signaling is sustained.[19] IL-35 is likely to act in a similar regulatory direction by suppressing effector lymphocytes, although direct malaria-specific evidence remains limited.[8] These observations argue against interpreting any single IL-12 family member as uniformly beneficial or harmful. Rather, cytokine kinetics, ratios, and the phase of infection are likely to be more informative than isolated measurements, particularly when considering biomarkers or therapeutic manipulation. Severe disease also reflects organ-specific consequences of inflammation. Endothelial activation, altered vascular permeability, anemia, metabolic disturbance, and tissue sequestration interact with systemic cytokine responses. Consequently, associations between a cytokine and severity do not necessarily establish causality. Longitudinal measurements before, during, and after treatment are needed to distinguish cytokines that drive pathology from those that rise as compensatory responses to tissue injury or high parasite biomass.

Cerebral malaria is among the most severe complications of P. falciparum infection and results from parasite sequestration together with dysregulated host inflammation in the cerebral microvasculature.[22] IFN-γ is required for effective antiparasitic immunity, but sustained Th1 activation can promote endothelial activation, leukocyte recruitment, and blood-brain barrier dysfunction.[23] IL-12 may therefore contribute to both protection and pathology through its ability to drive IFN-γ responses. IL-23/Th17 signaling is also

biologically plausible as a contributor to neuroinflammation, although direct human evidence is less complete than for the broader inflammatory response.[24] IL-27 may counterbalance these pathways by promoting IL-10 and restraining excessive T-cell activity.[25] Experimental studies additionally demonstrate that modifying inflammatory signaling can reduce neurological pathology without necessarily eliminating parasitemia.[26] Evidence for IL-35 in cerebral malaria is still mainly inferential, based on its established suppressive effects on effector T cells.[8]

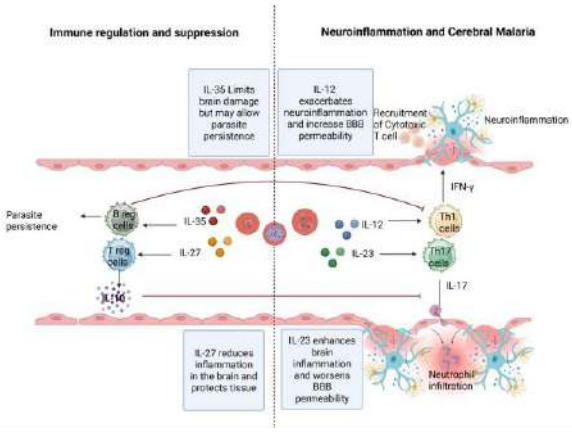


Figure No. 5: Balance between neuroinflammation and immune regulation in cerebral malaria. IL-12/IL-23-associated pathways may enhance inflammation, whereas IL-27 and IL-35 can restrain effector responses

Overall, cerebral malaria illustrates why therapeutic targeting of the IL-12 family would require careful attention to timing: early suppression could impair parasite control, whereas later regulation might reduce tissue injury.[24] The cerebral microenvironment adds another layer of complexity because systemic cytokines interact with endothelial cells, sequestered infected erythrocytes, platelets, monocytes, and brain-resident immune cells. Blood-brain barrier dysfunction is therefore unlikely to reflect a single mediator. A clinically useful model should integrate parasite sequestration with inflammatory and regulatory signals and should recognize that mechanisms identified in experimental cerebral malaria may not reproduce all features of human disease (Fig. 5).

RESULT

Antibody-mediated immunity is essential for control of blood-stage malaria and protection against reinfection,[27] IL-12 can support humoral responses indirectly through Th1-derived IFN-γ and may influence B-cell differentiation and class switching. Human vaccination studies also demonstrate that malaria-specific B-cell responses contribute to protective immunity.[28] IL-23 and IL-27 may modify follicular helper T-cell and B-cell activity, although their malaria-specific roles are less well defined than their effects on T-cell inflammation. IL-35, by contrast, is produced by regulatory B cells and can suppress effector immunity. The key implication is that the IL-12 family can influence antibody quality as well as cellular responses, but strong claims about individual family members should be made cautiously because direct clinical evidence remains limited.[8] Naturally acquired antibody protection depends on repeated exposure and the generation of durable memory B-cell and plasma-cell responses. Cytokines from helper and regulatory T-cell populations can influence germinal-center reactions, antibody affinity, and the persistence of memory (Table 1).

Table No. 1: IL-12 family of cytokines: immunological functions and malaria-related implications

Cytokine	IL-12	IL-23	IL-27	IL-35
Structure/subunits	Heterodimer (p35 + p40)	Heterodimer (p19 + p40)	Heterodimer (EBI3 + p28)	Heterodimer (p35 + EBI3)
Receptor components	IL-12Rβ1 + IL-12Rβ2	IL-12Rβ1 + IL-23R	IL-27Rα + gp130	Unclear; likely IL-12Rβ2/gp130
Primary producers	Induced by Plasmodium-infected antigen-presenting cells	Induced via TLR2/Dectin-1 (e.g, zymosan)	Expressed during the acute and resolution phases	Produced by Tregs upon stimulation
Main targets	CD4+, natural killer, and CD8+ T cells	Th17 cells	Multiple T cell subsets	Th17 and Th1 cells
Signaling pathways	STAT4	STAT3	STAT1/3	STAT1/4
Key immune functions	Stimulates cytotoxicity, Th1 differentiation, and IFNγ production	Maintains Th17 responses	Immunoregulatory stimulates IL-10; inhibits Th17 and Th1	Inhibits effector T cells; induces Tr35
Malaria-related role	Critical to early resistance to Plasmodium; low IL-12 is associated with severe/cerebral malaria	Role of the IL-23/IL-17 axis in malaria-associated anemia and inflammation	IL-27 controls a strong immune balance and memory in malaria; genetic variants affect susceptibility	Putatively implicated in function: negative regulation of the immune system process in cerebral malaria (T cells and B cells regulate inhibitory effects)
References	2,5	6,12,16	7,19,25	3,8

DISCUSSION

Since cytokine profiles vary according to the level of parasite burden and the degree of inflammation, members of the IL-12 family have been suggested as potential adjunct biomarkers. A recent umbrella review has found an association between cytokine levels and the severity of falciparum malaria.[21] IL-12 might indicate protective Th1 activity, while signals associated with IL-23/IL-17 could suggest increased inflammation. Variability in the assays is another obstacle, especially when dealing with low-abundance cytokines and when making comparisons between different laboratories.[29] The measurements of IL-12 family members should be seen as research biomarkers rather than as standalone diagnostic tests. The development of biomarkers could be improved by combining cytokine data with information on parasite density, age, previous exposure, treatment status, and markers of organ dysfunction.[8] Panels that include multiple variables are more likely to reflect the balance between inflammation and immune regulation than a single cytokine.

The IL-12 family does provide a number of possible immunotherapeutic approaches, but none of these is currently suitable for routine use in the treatment of malaria. Increasing IL-12 activity could boost Th1 immunity and promote parasite clearance, while inhibiting excessive IL-23/IL-17 signalling might help to reduce inflammatory damage.[5,6] IL-27 is more difficult to deal with since the same pathway can both enhance early immunity and later suppress inflammation.[7] Blocking IL-35 might in theory help to reinstate effector responses in cases of chronic immune suppression, although this idea is mainly based on evidence obtained outside the context of malaria.[8] The cerebral malaria indicate that careful regulation of inflammatory pathways can lead to an improvement in neuropathology, thus supporting the general idea of host-directed therapy.[23] Nevertheless, there is a considerable risk associated with cytokine manipulation - that it could either impair parasite control or exacerbate immunopathology. Systemic cytokine administration or broad neutralization could adversely affect many tissues, whereas more targeted or short-term approaches could theoretically offer a safer therapeutic window.

Cytokine modulation may also improve malaria vaccines. IL-12 is attractive as an adjuvant because it promotes Th1-biased cellular immunity and can enhance antigen-specific IFN-γ responses.[30] Effective vaccination nevertheless requires balanced cellular and humoral immunity, and excessive inflammatory signaling may be counterproductive.[13] IL-23 could support inflammatory recruitment but has a narrower therapeutic window because of its association with Th17-mediated pathology.[6] IL-27 may enhance early T-cell activation while later regulatory effects could attenuate vaccine responses, and IL-35 may suppress both T- and B-cell function.[8] These possibilities remain largely preclinical. The most realistic strategy is likely to involve transient and precisely timed cytokine modulation rather than sustained activation or blockade. Continued vaccine development must also account for parasite immune evasion and antigenic diversity, which remain major obstacles to durable protection.[31] Vaccine should therefore measure not only peak immunogenicity but also durability, functional antibody activity, T-cell quality, and evidence of excessive regulation. The optimal cytokine profile may differ between pre-erythrocytic vaccines, which rely heavily on cellular responses, and blood-stage vaccines, where antibody-mediated mechanisms are particularly important.

CONCLUSION

The IL-12 family plays a significant role in malaria by linking parasite detection to innate immune activation, T-cell differentiation, inflammation, and immune suppression. While IL-12 typically promotes protective Th1 and IFN-γ responses, IL-23 is more associated with Th17-related inflammation. IL-27 has a clearly context-dependent function, since it helps to initiate early immune activation but also restricts subsequent inflammation, and IL-35 is mainly suppressive. It is clear in severe and cerebral malaria, since the immune responses that are necessary for controlling the parasite can also cause tissue damage. The members of the IL-12 family should continue to be investigated as part of biomarker panels and as possible targets for carefully timed immunomodulation, direct clinical application is still too early to justify.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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Systematic Article

Facial Morphometry and Personality: A Systematic Review of Craniofacial Anthropometric Associations with Psychological Traits

Facial Morphometry and Personality

Piyush Kumar[1], Sanjeev Kumar Jain[2] and Prerna Gupta[3]

ABSTRACT

Introduction: Facial morphometry, the quantitative assessment of craniofacial morphology, offers a potential means of investigating the biological and evolutionary foundations of personality and behavior.

Place and Duration of Study: This review was conducted at the Teerthanker Mahaveer Medical College & Research Center, Moradabad from November 2025 to April 2026.

Methods: This systematic review was conducted and reported in accordance with the PRISMA 2020 guidelines. PubMed, Scopus, Web of Science, PsycINFO, and Embase were systematically searched for studies that used quantitative two- or three-dimensional facial anthropometry to examine personality or behavioral traits in healthy populations. Twenty eligible publications involving more than 10,000 participants were included, comprising 18 primary studies, one meta-analysis, and one additional eligible report.

Results: The evidence indicated that the facial width-to-height ratio (fWHR) was consistently, although modestly, associated with status-seeking behavior and social dominance. A meta-analytic effect size of r = 0.16 was reported for the association between fWHR and perceived threat. Higher fWHR was also associated with dominance in humans and "alpha" status in nonhuman primates. These relationships appeared to be context-dependent: status-seeking could manifest as aggression in competitive settings or as achievement-oriented behavior in regulated environments.

Conclusions: Craniofacial morphology, particularly fWHR, shows a small but relatively consistent association with status-seeking behavior and social dominance across species. However, these associations vary according to context and may be moderated by sex and ethnicity. Methodological heterogeneity and potential confounding limit the usefulness of facial measurements as biological biomarkers. Therefore, these findings should not be interpreted as evidence of causal relationships.

Key Words: Facial morphometry; Craniofacial anthropometry; fWHR; Personality traits; Systematic review

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INTRODUCTION

The study of facial morphometry, including the quantitative analysis of facial forms, dimensions and structural relationships, has critical insights in a number of diverse scientific fields from forensic anthropology to developmental biology and psychology[1].

This interdisciplinary study examines the complex genetic and environmental factors that shape human facial diversity, providing a unique insight into human evolutionary processes and individual variation[2,3]. Beyond its importance in our understanding of origin, the field of facial morphometry is becoming increasingly important in clinical diagnosis, assisting with the diagnosis of syndromic conditions and guiding reconstruction surgeries[4]. Furthermore, the advances in digital imaging and computational techniques have greatly improved the precision and scope of facial analysis, enabling the quantification of subtle morphological variations with unprecedented detail[5]. This sophisticated approach makes it possible to systematically measure the norms and deviations in the face, which historically has been critical in anthropometric studies[6].

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The modern use of digital facial anthropometry takes these basic concepts and builds upon them to allow more detailed quantitative and qualitative evaluation of facial features, which aids the identification of genetic links with certain facial features[7]. Indeed, morphology of the face is greatly affected by genetic factors, so proper characterization, sometimes called facial phenotyping, is important to study inherited characteristics and their consequences for health and disease within populations[8,9]. While traditional anthropometric landmarks provide a traditional set of homologous measuring points, more recently there has been an increasing emphasis on using digital scans for facial measurement, although there are associated difficulties of determining exact homology between complex 3D surfaces[10]. This has resulted in the adoption of geometric morphometrics that involves the rigorous quantification of biological shapes based on Procrustes analysis to distinguish between sizes, shapes and forms and also helps visualize the differences through deformation grids[11]. The human face is one of the main interfaces in social interaction, with its complex morphology affecting how we communicate, express emotions, and even perceive attractiveness[12]. Genetics can explain much of this variation in facial morphology, with many genetic loci implicated in different aspects of normal-range facial variation across human populations[13,14]. The synthesis of computational approaches, especially those that make use of machine learning techniques, has allowed a data-driven investigation of these genetic influences in a manner that reduces researcher bias inherent in hypothesis-driven approaches[15]. For example, genome-wide association studies have started to identify specific loci linked to different facial features that can give molecular explanations about the heritability of facial morphometry[16]. Moreover, research has shown that the shape and look of the face is affected by a host of variables including genetics, ethnicity, age, gender, and general health[17,18].

METHODOLOGY

This review was conducted at the Teerthanker Mahaveer Medical College & Research Center, Moradabad from November 2025 to April 2026. Studies involving healthy human participants were included, while those involving craniofacial deformities, congenital syndromes, surgically altered facial structures, or animals were excluded. Eligible studies used quantitative facial morphometric measurements such as facial width, symmetry, eye spacing, or nasal indices obtained through photography, 3D imaging, stereophotogrammetry, or manual assessment. Studies based only on subjective ratings or AI-generated faces were excluded.

Search Strategy: A comprehensive systematic search was conducted across five electronic databases: PubMed, Scopus, Web of Science, PsycINFO, and Embase. The search period covered literature from database inception to October 31, 2025. The search strategy was developed using a combination of Medical Subject Headings (MeSH) and free-text terms related to three core concepts: (1) craniofacial anthropometry (e.g., "fWHR", "facial morphometry", "bizygomatic width"), (2) personality and behavioral traits (e.g., "dominance", "aggression", "Big Five"), and (3) measurement quantitative methods. A total of 1,842 records were found using the search strategy (PubMed: 412, Scopus: 503, Web of Science: 387, PsycINFO: 228, Embase: 256, Manual search: 56). Following the elimination of duplicates 632 (1,210 records remained) were to be screened in terms of title and abstract. Out of these 1,050 were omitted as irrelevant. There are 160 full-text articles that were evaluated as being eligible. Based on them, 140 have been filtered out due to the following reasons: no quantitative anthropometry (n = 54), no personality outcome (lack of personality outcomes (n = 38), no human clinical/surgical population (n = 16), insufficient methodological description (n = 11), and no full text (n = 21). In the end, it was possible to identify 20 studies that fit the inclusion criteria.

Data Extraction: All the relevant information was collected using a standardized data extraction form to all the included studies. The variables that were extracted were the name of the author, the year of publication and the country where the study was conducted, the study design, and sample characteristics. Data on the technique employed to measure the face, whether 2D photography, 3D photography or manual anthropometry was employed was captured. The craniofacial anthropometric measurements that were specific in each of the studies were recorded along with the personality assessment instruments that were used in assessing the psychological traits.

RESULTS

A total of 20 sources were considered for inclusion in this review, consisting of 18 primary research studies, 1 systematic review incorporating meta-analysis and one research protocol. The major studies have shown a geographical spread of populations from North America (Canada, USA), Europe (UK, Spain), East Asia (China, Japan), South Asia (India) and Middle East (Turkey).

Table No. 1: Study Characteristics

Study	Country	Design	Sample Size	Measurement Method	Personality Measures
Carré & McCormick, 2008	Canada	Lab exp. + field	88, 21, 112	2D photographs	Aggression measures
Stirrat & Perrett, 2010	UK	Experimental	143, 62	2D photographs	Trust game behaviour
Haselhuhn & Wong, 2012	USA	Experimental	192, 103	2D photographs	Unethical behaviour
Geniole et al., 2015	Global	Meta-analysis	>10,000	Multiple	Threat, dominance
Sato et al., 2021	Japan	Field	482	2D photographs	Sports performance, aggression
Lv et al., 2022	China	Cross-sectional	904	2D photos + angles	16PF personality factors
Srivastava et al., 2025	India	SR	Meta-analysis	236	Various
Gabarre-Mir et al., 2017	Spain	Cross-sectional	82	Manual + 2D	Alexithymia
Gabarre-Armengol et al., 2019	Spain	Cross-sectional	70	Manual	Coldheartedness
Guerrero-Apolo et al., 2018	Spain	Cross-sectional	131	Profile photos	Impulsiveness
Guerrero-Apolo, 2020	Spain	Cross-sectional	48	Profile photos	Impulsiveness, cognition
Gülcen et al., 2021	Turkey	Cross-sectional	303	Multiparametric measures	Aggression (Buss-Perry)
Srivastava et al., 2025	India	Cross-sectional	295	Manual + photos	Big Five
Lefevre et al., 2014	UK/USA	Primate cross-sectional	64	2D anthropometry	Assertiveness
Martin et al., 2019	Belgium	Primate	38	2D photos	Dominance
Borgi & Majolo, 2016	Global	Comparative	145 (species-level)	2D	Dominance style
Wilson et al., 2014	USA	Primate	64	2D	Neuroticism, attentiveness

Table No. 2: Jaw Width & Cheekbones (Bizygomatic/Bigonial)

Study (Citation)	Location & Design	Sample Characteristics	Predictor Variable	Outcome Variable(s)	Key Findings & Direction of Association
Gabarre-Mir et al.	Cross-Sectional (Spain)	N=82 Males	Bizygomatic Arch Contraction (Cheek vs. Jaw)	Self-Sufficiency, Alexithymia	**Positive.** Narrower cheekbones relative to jaw (Contraction) linked to higher Self-Sufficiency and Alexithymia (low emotional expression).
Gabarre-Armengol	Cross-Sectional (Spain)	N=70 Adults (Mixed Sex)	Width Difference (Jaw minus Cheek width)	Psychopathy ("Coldheartedness")	**Positive.** Wider jaws (relative to cheeks) linked to higher "Cold heartedness" and Self-Reliance. Effect stronger in women.
Lv et al. (2022)	Cross-Sectional (China)	N=904 Students	Mandibular Line Angle	Social Boldness, Vigilance	**Positive.** Wider/Squarer jaws (smaller angle) predicted higher **Social Boldness** in men and higher Vigilance in women.
Srivastava et al. (2025)	Cross-Sectional (India)	N=295 Medical Students	Bizygomatic Width, Bigonial Width	Agreeableness, Extraversion	**Negative.** Wider Bizygomatic width linked to **lower Agreeableness**. **Positive.** Wider jaws linked to **Extraversion** in females.

DISCUSSION

The present systematic review examined the available evidence on the relationship between craniofacial morphometry and personality or behavioral characteristics. Overall, the included literature suggests that certain facial measurements, particularly facial width-to-height ratio (fWHR), jaw and cheekbone dimensions, and forehead morphology, have been associated with psychological and behavioral traits. However, the magnitude and direction of these relationships were not uniform across studies, populations, sexes, or measurement approaches. Therefore, the findings are more appropriately interpreted as evidence of small and context-dependent associations rather than evidence that facial morphology can reliably determine an individual's personality. This interpretation is consistent with the abstract, which reports a modest association for fWHR and perceived threat ($r = 0.16$) and emphasizes methodological heterogeneity and potential confounding[19,20]. Among the craniofacial parameters considered, fWHR emerged as one of the most frequently investigated measurements. The reviewed evidence indicated associations between greater fWHR and outcomes related to dominance, perceived threat, status-seeking, aggression, and social behavior. Importantly, these associations appeared to depend on the social context in which behavior was assessed[21]. The manuscript indicates that status-seeking associated with fWHR may be expressed differently across competitive and regulated environments, suggesting that the relationship cannot simply be interpreted as an association between a wider face and aggression[22,23]. This distinction is particularly important because personality and behavior are complex constructs influenced by social, environmental, developmental, and biological factors[24]. Thus, fWHR may represent one morphological correlate among many rather than an independent marker capable of predicting behavior at the individual level. The review also identified potentially relevant associations involving the mandibular and bizygomatic regions. Gabarre-Mir et al. reported that narrower cheekbones relative to jaw dimensions were associated with greater self-sufficiency and alexithymia. Gabarre-Armengol et al. reported associations of relatively wider jaws with coldheartedness and self-reliance, with a stronger relationship among women. In the Chinese study by Lv et al., wider or squarer jaw morphology was associated with greater social boldness among men and vigilance among women. Similarly, the study by Srivastava et al. reported that greater bizygomatic width was associated with lower agreeableness, whereas wider jaws were associated with extraversion among females. Collectively, these findings suggest that mandibular and cheekbone dimensions may have relationships with selected personality domains, but the variation according to sex and the specific personality construct indicates that these associations are unlikely to be universal[25-28]. This finding is particularly noteworthy because it does not necessarily conform to the simpler hypothesis that relatively wider faces are consistently associated with aggressive behavior. In addition, the included capuchin study reported relationships between relative lower-face length, neuroticism, and attentiveness, whereas Srivastava et al. reported an association between greater vertical forehead length and higher intellect and conscientiousness among males[29]. These findings demonstrate that different dimensions within the same anatomical region may show associations with different behavioral constructs and should therefore not be treated as interchangeable facial markers[30]. The present review nevertheless highlights an interesting interdisciplinary area linking anatomy, anthropometry, psychology, and behavioral science. Its findings suggest that craniofacial measurements may contribute to research investigating biological correlates of behavior, particularly when combined with demographic, psychological, genetic, and environmental information[31,32]. Future studies should prioritize larger and ethnically diverse samples, prospective or longitudinal designs where feasible, standardized 3D morphometric methods, validated psychometric instruments, sex-stratified analyses, and careful adjustment for potential confounding variables. Replication across independent populations will be particularly important before individual craniofacial measurements can be considered reproducible correlates of specific personality traits. The methodological limitations of this review are a number of them. First, only studies in English language were taken in consideration and that can bring language bias. Second, the majority of human experiments were cross-sectional, which did not allow them to cause a relationship between the morphology of the face and psychological characteristics. Third, personality tests were based mostly on self-report tests that are susceptible to social desirability biasness.

CONCLUSION

This study demonstrated that facial morphometry is a legitimate biological indicator of personality that fWHR is an effective, evolutionally preserved signal of status-seeking motivation (dominance/formidability) whereas mandibular and forehead measures are effective predictors of social agency and impulse control, respectively. These correlations are motivated by organizational implications of sex hormones and this offers a non-invasive glimpse into the biological basis of personality.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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Integrative Article

Antinatalist Attitudes and their Implications for Reproductive Health Services: An Integrative Review

Nawal Abdulghani

ABSTRACT

Introduction: Fertility reduction has become as a critical demographic problem in Saudi Arabia, accompanied by fast-paced changes in society, education, and economy. This review aims to explore antinatalism as an emerging conceptual lens for understanding hesitant, negative or conditional attitudes toward childbearing in Saudi Arabia, without making assumptions about the relationship between antinatalism and fertility decline.

Objective: This review aims to explore antinatalism as an emerging conceptual lens for understanding hesitant, negative or conditional attitudes toward childbearing in Saudi Arabia, without making assumptions about the relationship between antinatalism and fertility decline.

Methodology: We conducted an integrative review at Umm Al-Qura University, Makkah, Saudi Arabia, from June 2025 to March 2026, because empirical studies explicitly addressing antinatalism in Saudi studies remain scarce, while evidence on this topic is available in quantitative, qualitative, and interpretive research. The review analysed the literature on fertility attitudes, childbearing intentions, delayed motherhood, family planning, contraceptive practices, reproductive awareness, and women's reproductive experiences in Saudi Arabia.

Result: The review found that there is no substitutional evidence for explicit antinatalism is Saudi Arabia. Reproductive reluctance appears to be influenced by a complex interaction of life-stage, education, employment, occupational prospects, fertility awareness, family and community expectations, partner influence, and concerns about responsible parenthood. It was revealed that Saudi attitudes toward reproduction have become more oriented toward preparation and readiness than against parenthood.

Conclusion: Antinatalism in Saudi can be viewed as an evolving discourse rather than an explanatory framework for low fertility rates.

Keywords: antinatalism; fertility decline; reproductive decision-making; childbearing attitudes; family planning.

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INTRODUCTION

Fertility decline has become an important demographic issue nationally and internationally. The General Authority for Statistics indicates that the total fertility rate in Saudi Arabia declined from 2.8 births per woman in 2011 to 2.1 births per woman in 2022, indicating a notable downward trend in fertility[1].

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While official labor-market releases show major gains in women's economic participation[2]. These two trends are important when combine together; fertility is changing in society where women's educational, occupational and social roles are also changings rapidly. In Saudi Arabia, reproductive behaviour cannot be understood solely through demographic counts. It must also be interpreted through the meaning that individuals attach to marriage, parenthood, timing responsibility and quality of life. One concept that may be useful in this regard is antinatalism. In this strict philosophical sense, antinatalism refers to the belief that bringing new people into existence is undesirable[3]. In practice, however, attitudes related to antinatalism may appear in a spectrum ranging from philosophical opposition to childbearing, to ambivalence about parenthood, to preferences for delaying or limiting family size due to ethical, social, psychological, health, or economic concerns[4]. In social research, the concept can also function more broadly as a lens for examine

hesitant, negative, or highly conditional attitudes toward childbearing[5,6]. This broader use is especially relevant where explicit identification with antinatalism is rare, but where indirect forms of reproductive reluctance may nonetheless be emerging. Recent Saudi literature describes declining birth and fertility trends alongside changing attitudes toward childbearing and parenthood and appears to contain more studies on fertility attitudes, parenthood intentions, family planning and reproductive decision-making[7,8] than studies explicitly using the term antinatalism. That makes an integrative review especially suitable, because it can synthesize diverse forms of evidence and identify how antinatalist-type attitudes are discussed, implied or operationalised in Saudi context.

This review is therefore important for three reasons. First, it can clarify whether antinatalism attitudes are actually present in Saudi scholarship or public health discussion, rather than assumed. Second, it can distinguish antinatalism form adjacent concepts such as delayed childbearing, fertility concerns, low fertility intentions, or family planning. Third, it can help policymakers, educators, and women's health professionals interpret fertility delice more carefully and avoid simplistic causal claims. Therefore, the aim for the study is to synthesis published literature relevant to antinatalist attitudes in Saudi Arabia and examine how understanding emerging discourse may inform supportive approach to fertility and family formation, without assuming that antinatalism is the direct cause of fertility decline.

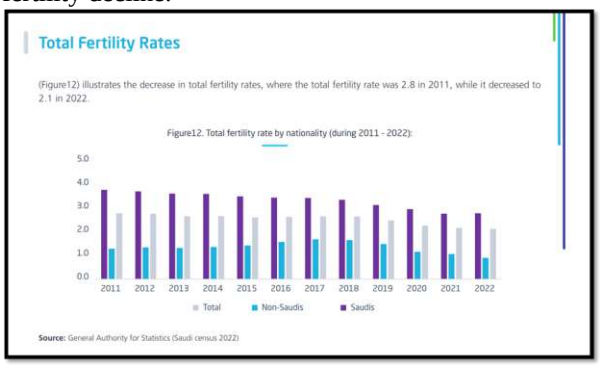


Figure No.1: Total fertility rate from 2011 to 2022

METHODOLOGY

An integrative review was conducted at Umm Al-Qura University, Makkah, Saudi Arabia from June 2025 to March 2026. An integrative review is especially suitable when topic is conceptually broad, draws on multiple study designs and requires synthesis across empirical and interpretive literature. The integrative review is the most appropriate approach for this study because the concept of antinatalism in Saudi context is not yet represented by a single, clearly defined body of empirical research. Instead, relevant evidence is dispersed across different forms of literature, including studies on fertility attitudes, childbearing intentions, family planning, delayed parenthood, reproductive knowledge and women's social experiences. Integrative reviews are particularly suitable for topic because they allow the inclusion and synthesis of diverse methodologies, including experimental and non-experimental research, qualitative and quantitative studies, and other relevant forms of evidence, thereby enabling a more comprehensive understanding of complex and emerging phenomena[9]. This makes the design especially valuable for this study, where the aim to interpret the social, cultural and ethical meanings surrounding reproductive attitudes. In addition, the integrative review supports the development of broader conceptual insights and practice implications by bringing together evidence from varied sources in a critical manner[10].

Literature Search

The literature search focused on concepts related to antinatalism and reproductive decision-making. Search terms included antinatalism, fertility attitudes, childbearing intentions, delayed childbearing, family planning, contraception, reproductive autonomy, fertility awareness, and Saudi Arabia. Because studies explicitly using the term "antinatalism" in Saudi Arabia were scarce, the search was broadened to include studies examining reproductive attitudes and behaviours that could provide insight into reluctance toward childbearing, conditional parenthood, delayed childbearing, and reproductive hesitation.

Eligibility of Evidence

Priority was given to peer-reviewed empirical studies and official Saudi statistical sources. Studies were considered relevant when they addressed fertility attitudes, childbearing intentions, family planning, contraceptive practices, reproductive knowledge, delayed parenthood, reproductive experiences, or social and demographic factors influencing reproductive decision-making in Saudi Arabia. Studies from the broader international literature were also considered when they contributed important conceptual or clinical perspectives on antinatalism, reproductive counselling, fertility awareness, or reproductive decision-making.

Sources of Evidence

The evidence base included official Saudi statistical reports on fertility and female labour-force participation, national and regional cross-sectional studies, studies of fertility awareness and childbearing intentions, research on family planning and contraception, and literature examining women's reproductive experiences and reproductive counselling. Relevant conceptual literature on antinatalism was also included to support interpretation of the emerging discourse surrounding childbearing hesitation and conditional parenthood.

Data Extraction and Organization

Relevant information from the included literature was organized according to the main themes of the review. These included fertility trends, attitudes toward childbearing, delayed parenthood, education and employment, fertility awareness, family and partner influence, family planning, reproductive counselling, and the role of health professionals. Particular attention was given to distinguishing explicit antinatalist beliefs from related but conceptually different phenomena such as delayed childbearing, reduced fertility intentions, conditional parenthood, and family-planning practices.

Data Synthesis

A narrative and thematic synthesis was used because the included evidence represented different study designs, populations, outcomes, and conceptual perspectives. Findings were compared across studies to identify recurrent patterns, areas of agreement, and important differences. The synthesis focused on whether antinatalist-type attitudes were explicitly documented in the Saudi literature or whether reproductive reluctance was more appropriately understood in relation to social, educational, occupational, economic, relational, and reproductive-health factors. The interpretation was deliberately cautious, and declining fertility was not treated as direct evidence of antinatalism. This approach was consistent with the overall objective of examining antinatalism as a possible conceptual lens rather than assuming it to be an established cause of fertility decline.

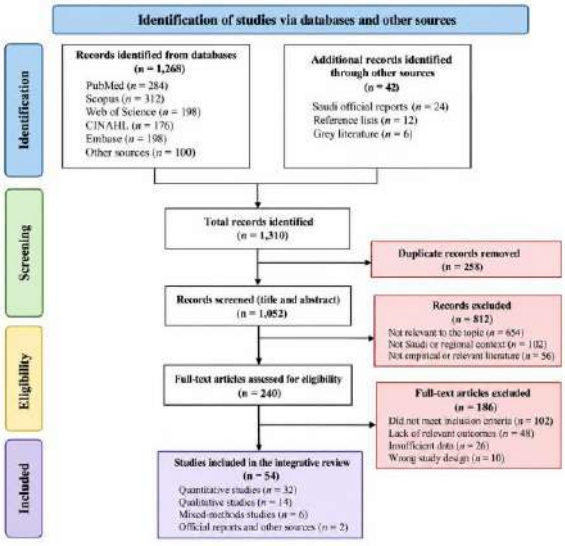


Figure No.2: Identification of studies via databases and other sources.

RESULTS

Saudi fertility decline is an important backdrop to this review. According to data from General Authority for Statistics indicates that the total fertility rate declined from 2.8 to 2.1 births per woman between 2011 and 2022, whereas women have made substantial progress in term of education and workforce participation[11,12]. However, demographic decline alone should not be read as evidence that a society has become antinatalist. This distinction matters because it protects the argument from which overreach. The present review begins from the premise that declining fertility makes the question important, however does not prove the answer. Antinatalism is therefore explored here a potential discourse or attitudinal lens not as demonstrated casual force. The most consist findings from the literature is that explicit antinatalism is not yet well documents is Saudi Arabia. The 2025 national study on women's attitudes toward fertility and childbearing did not identify a widespread rejection of parenthood; instead, it showed that attitude vary according to life stage and psychosocial factors. Similarly, the study of health-professions students found that most participants wanted children and held positive views of parenthood, even though many also planned to delay childbearing[13].

In essence, the Saudi case is not characterized by anti-reproductive sentiments as much as it is by conditions. Parenthood may increasingly be perceived as desirable only under certain circumstances: after educational completion, after career stabilization, after marriage, or when financial and emotional are favourable. In sociological terms, this reflects a movement form normative parenthood toward negotiated parenthood. Such attitude may resemble antinatalism at the margins, especially childbearing is postponed repeatedly or viewed as too burdensome under present conditions, however, they do not have the amount to broad philosophical rejection of childbirth[14]. Saudi studies consistently show that reproductive decision is influenced by education, employment and career aspiration were discussed as influential in decision-making, alongside occupation, income, marriage duration, and service access. Similarly, the national childbearing-attitudes study linked reproductive views to life-stage and educational variables. These findings align with the border social transformation documented in Saudi labor statistics, where women's workforce participation has increased substitutionally, indicating that reproductive behaviour is shaped by both socioeconomic and life-course factors[15-20]. It is evident that increased access to education and employment for women is clearly a positive development. Nevertheless, it also influences the timing of marriage and parenthood. When career-building and economic participation become central to adulthood, childbearing is more likely to be delayed, strategically planned or limited. When it is difficult to balance between work and family commitments, some women may view parenting as something difficult and challenging with their career goals or an impossibility because competing life demands[21].

Table No. 1: Summary of Results of the Integrative Review

Theme	Main findings
Fertility trend in Saudi Arabia	The total fertility rate declined from 2.8 births per woman in 2011 to 2.1 births per woman in 2022. This decline occurred alongside major social changes, including increasing women's education and workforce participation.
Evidence of explicit antinatalism	The reviewed literature did not provide strong evidence that explicit antinatalism is widespread in Saudi Arabia. Most studies described changing reproductive attitudes rather than a broad rejection of parenthood.
Conditional attitudes toward parenthood	Parenthood was generally viewed positively, but childbearing was increasingly linked to certain conditions such as completion of education, career stability, marriage, financial security, and emotional readiness.
Education and employment	Education, employment, career aspirations, occupation, income, marriage duration, and access to services were identified as factors influencing reproductive decision-making. Increasing women's participation in education and employment was also associated with changes in the timing and planning of childbearing.
Fertility awareness and reproductive knowledge	Delayed childbearing may coexist with limited awareness of age-related fertility decline. The review highlighted the importance of improving fertility knowledge, particularly among young adults and university students.
Family and partner influence	Reproductive and family-planning decisions were influenced by partner involvement, family expectations, and community attitudes, indicating that reproductive decisions are shaped by both individual and social factors.
Family-planning experiences	Women's family-planning experiences were affected by limited knowledge, misconceptions, partner influence, and inconsistent access to supportive reproductive guidance.
Role of health professionals	Nurses, midwives, obstetricians, and other health professionals may influence reproductive decision-making through counselling and fertility education. Their influence depends on the quality, tone, and assumptions underlying the counselling provided.
Barriers affecting reproductive counselling	Health professionals may face barriers including limited time, insufficient training, personal beliefs, and structural constraints, which can influence the quality of contraceptive and reproductive-health counselling.
Overall interpretation	Antinatalism appears more appropriately understood as an emerging discourse or conceptual lens rather than a proven cause of fertility decline in Saudi Arabia. Reproductive decisions appear to be influenced by education, employment, timing, fertility knowledge, partner and family influence, and concerns about readiness and responsible parenthood.

DISCUSSION

A more critical of the literature suggests that the role of health professionals in relation to antinatalist or childbearing-hesitant attitude is neither uniformly protective nor inherently neutral. Midwives, nurses, obstetricians and other health professional dealing with women during reproductive age are often positioned as trusted source of fertility information and reproductive guidance, yet the evidence indicates that their impact depends heavily on the quality, tone and assumptions embedded in counselling[22]. In the Saudi context, women's experiences of family planning were shaped by limited knowledge, misconception, partner influence and inconsistent access to supportive guidance, which suggests that professional input my either reduce uncertainty or leave it unresolved[23]. Similar findings emerge from studies of border evidence in that women favour respect, individuality, and collaborative approaches to contraceptive counselling rather than directive methods, which suggests that inadequate counselling might exacerbate rather than mitigate reproductive ambivalence among these women[24]. Research on provider counselling research after childbirth also reveals the possibility that clinical encounters might have an impact on family planning decisions among women, which further highlights the importance of understanding the effects of provider encounters not only on contraceptive use but also reproductive decision making[25]. On the other hand, systematic review studies about providers' perspectives reveal the presence of different barriers for health care professionals that include time pressures, lack of training, personal beliefs, and structural constraints, which might contribute to how they deliver contraceptive counselling and interpret women's

concerns regarding reproductive issues[26]. This is especially important in relation to midwives and obstetricians, whose authority in reproductive care may legitimize either fertility-supportive counselling or a more risk-focused discourse that unintentionally frames childbearing as medically, socially, or personally burdensome. International guidance recognizes health workers as central to family-planning service delivery and task-sharing models, but this also underscores the responsibility of those professionals to provide balanced, evidence-based, and women-cantered care rather than care that privileges institutional convenience or provider preference. First, fertility literacy should be strengthened[27]. The evidence shows that delayed childbearing may coexist with limited awareness of age-related fertility decline. This suggested the need for better education on fertility timing, reproductive health, life-course planning, especially among young adult and university students[28-31].

CONCLUSION

The present integrative review implies that antinatalism in Saudi Arabia can be regarded as an emerging paradigmatic approach rather than a proven cause of declining fertility rate. The official Saudi data and published Saudi studies confirm demographic changes show evolving attitudes toward fertility, family planning, and parenthood. Nevertheless, the existing literature suggests that the claim about widespread prevalence of antinatalism in Saudi Arabian society cannot be supported nor can it be considered a cause for fertility decline independently form other reasons. The evidence implies to a reproductive decision shaped by education, employment, delayed timing, knowledge gaps, partner and family influence, and ethical concerns about readiness and responsible parenthood.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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Case Report

A Case of Diffuse Palmoplantar Keratoderma in a Middle-aged Male

Ella Finarsih ES[1], Dina Arwina Dalimunthe[1], Kristo Alberto Nababan[1] and Jesslyn Jesslyn[2]

ABSTRACT

Introduction: Palmoplantar keratoderma (PPK) represents a heterogeneous group of disorders characterized by abnormal thickening and hyperkeratosis of the palms and soles. The hereditary diffuse type often begins in childhood with progressive thickening and may be associated with nail dystrophy.

Place and Duration of Study: This study was conducted at the Dermatology and Venereology Department, Faculty of Medicine Universitas Sumatera Utara, Universitas Sumatera Utara Hospital, Medan, Indonesia from 06 May 2025 to 16 May, 2025.

Case Presentation: A 43-year-old male who presented with progressive thickening, fissuring, and painful hyperkeratotic plaques on both palms and soles since childhood. Family history revealed similar conditions in multiple relatives, suggesting a hereditary pattern.

Findings: Clinical examination showed diffuse hyperkeratotic plaques with fissures, nail dystrophy, and extension to dorsal surfaces. Histopathology demonstrated hyperkeratosis and acanthosis without malignancy. **Management**: The patient was treated with topical desoximethasone combined with salicylic acid, urea cream, and oral cetirizine, with gradual improvement within 10 days.

Conclusion: This case highlights the chronic and disabling nature of PPK, its hereditary pattern, and the importance of early recognition and symptomatic treatment to improve quality of life.

Key Words: Case Report, Diffuse PPK, Hyperkeratosis, Palmoplantar Keratoderma

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INTRODUCTION

Palmoplantar keratoderma (PPK) is a heterogeneous group of dermatological disorders characterized by abnormal thickening of the skin on the palms and soles due to hyperkeratosis.[1,2,3] It is classified into hereditary and acquired forms, with further subtypes based on morphology: diffuse, focal, punctate, or striate.[2] Inherited forms are commonly associated with keratingene mutations and may have systemic associations, while acquired forms may result from chronic irritants, drugs, or systemic conditions.[2,3] Although not life-threatening, PPK can significantly impair quality of life due to pain, fissures, and cosmetic burden.[1]

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CASE REPORT

A 43-year-old Batak male presented with thickened, hardened, and painful skin lesions on both palms and soles since the age of five. The lesions progressively worsened, extending to the dorsal surfaces, causing painful fissures, pruritus, and functional limitation. Family history revealed similar conditions in his grandmother, father, uncle, sibling, and daughter.

On examination on 06 May 2025, diffuse well-demarcated hyperkeratotic plaques with fissures and post-inflammatory hypopigmentation were observed on palmar and plantar regions bilaterally, extending to dorsum of hands and feet as shown in Fig. 1.

Histopathology from a punch biopsy of the plantar lesion revealed hyperkeratosis and acanthosis without evidence of malignancy (Fig. 2). A clinical diagnosis of

diffuse hereditary PPK was made. Treatment included desoximethasone with salicylic acid 5% for palms, 10% for soles, urea cream (10%), and oral cetirizine. The patient was advised to maintain emollient use, avoid trauma, and protect the hands and feet. On follow-up at day 7 (13 May 2025) and day 10 (16 May 2025), gradual improvement was observed with thinning of hyperkeratotic plaques, decreased fissuring, and symptom relief (Fig. 3 and 4).



Figure No.1: Clinical presentation of diffuse hyperkeratotic plaques with fissures on palms and soles. Nail dystrophy with yellow discoloration was noted.

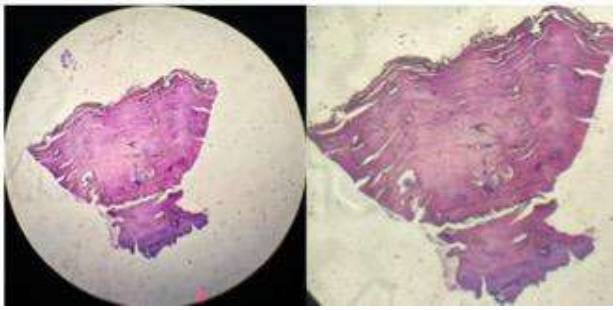


Figure No. 2: Histopathological image showing hyperkeratosis and acanthosis without malignancy



Figure No. 3: Clinical improvement at day 7 with thinning plaques and reduced fissuring

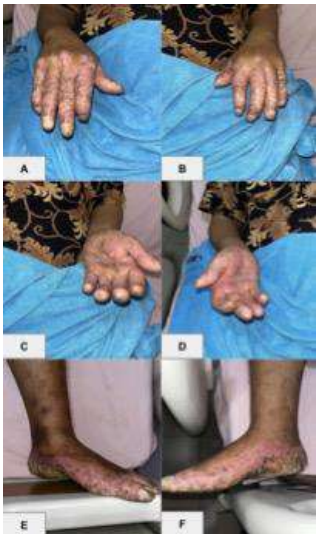


Figure No. 4: Further clinical improvement at day 10 with desquamation and reduced pain

DISCUSSION

PPK may present in hereditary or acquired forms. The hereditary diffuse type, as in our case, often begins in childhood with progressive thickening and may be associated with nail dystrophy. Mutations in keratin genes (e.g., K1, K9, K6a, K106) disrupt keratinocyte stability, resulting in hyperkeratosis.[4,5]

The main differential diagnosis includes palmoplantar psoriasis and hyperkeratotic eczema. Psoriasis is typically associated with lesions elsewhere on the body and characteristic nail changes, while hyperkeratotic eczema is usually pruritic with erythematous borders and adult onset.[6,7]

Histopathology in PPK is usually non-specific, showing hyperkeratosis, acanthosis, and sometimes parakeratosis.[3]

Treatment remains symptomatic, aimed at softening and reducing hyperkeratosis. Topical keratolytics (salicylic acid, urea), emollients, and corticosteroids are the mainstay. In severe or resistant cases, systemic retinoids may be considered. Although prognosis is good regarding life expectancy, chronic symptoms often impair quality of life.[4]

CONCLUSION

Diffuse hereditary palmoplantar keratoderma should be considered in patients presenting with chronic hyperkeratotic plaques of palms and soles, especially with a strong family history. Early diagnosis and symptomatic treatment with keratolytics, emollients, and topical corticostroids can significantly improve patient comfort and quality of life.

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Conflict of Interest: The study has no conflict of interest to declare by any author.

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- The start of the introduction should be Relevant. Reasons and Importance of the study should be clear.
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- In the introduction to much reference should not be entered

METHODS

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- In this link write the goals of the study.

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DISCLOSURE

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- Any company or institution who has financially contributed to the study must be acknowledged.

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- When appropriate, may be included.

ACKNOWLEDGMENTS

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Note:

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